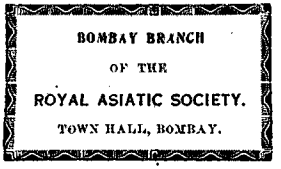
General Report.

Survey of India

1922-23 to 1926-27

With Index for
1904-05 To 1926-27



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Survey of India.

GENERAL REPORT

FOR 1922-23.

To 1926-27

From 1st October 1922

To 30th September 1923.

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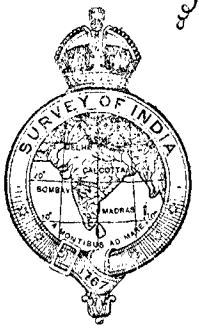

PREPARED UNDER THE DIRECTION OF

Colonel C. H. D. RYDER, C.B., C.I.E., D.S.O., R.E.,

SURVEYOR GENERAL OF INDIA.

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6. ,, Indian sheets of "La Carte Internationale du Monde," scale $\frac{1}{1,000,000}$.
7. ,, 'Southern Asia' series, scale $\frac{1}{2,000,000}$.

Survey of India.

GENERAL REPORT,

1922—23.

From 1st October 1922

To 30th September 1923.

PART 1.—GENERAL REMARKS.

I.—INTRODUCTION.

1. The main parts of this report, as shown in the "Contents" on the opposite page, are *Part 2—Work of Field Parties, &c.*, summarising the operations of the field parties, grouped under appropriate headings; and *Part 3—Office Work*, which gives a brief account of the year's progress in the head-quarters and other offices.

2. An abstract showing the progress of the topographical programme assigned to the department in 1905, will be found in Table I on page 5. From this it will be seen that the out-turn of topographical survey during the current year was 61,648 square miles; and that this brings the total progress since 1905 to 688,217 square miles, leaving 1,133,383 square miles still to be done.

3. The first Index map, at the end of this report, shows the progress of the topographical programme both in survey and in publication, while the remaining six indexes show the progress in publication of the various series of maps appertaining to the scheme.

4. Table III on page 36 gives a list of the new publications of the Calcutta Offices during the year. Lists of new maps are published monthly.

5. The main events of the year are summarised below:—

(*a*) A record out-turn of 61,648 square miles of topographical survey was completed. There has been a steady increase since the year 1918-19 (*vide* Table I) and the previous

record of 55,786 square miles surveyed in 1913-14 has now been surpassed, although the number of topographical parties employed has remained the same, *viz.*, 12.

(*b*) The work of the Trigonometrical Survey has again been considerably curtailed owing to financial stringency, and no field work of the astronomical, pendulum and base lines parties was carried out.

(*c*) The issues of maps to the public and Government officials continued to increase.

(*d*) The increased usefulness of the department, apart from its normal topographical work, may be gauged by the increase in receipts from outside sources for work done. These receipts in the financial year 1913-14 amounted approximately to Rs. 9,36,000 and in 1922-23 to Rs. 24,67,000.

(*e*) A new Survey Circle for Burma with a Superintendent in charge and with headquarters at Maymyo was formed on 11th April 1923. The formation of this circle has been sanctioned for a period of three years only in the first instance.

(*f*) A Survey party has been formed to carry out traverse work in Bhopāl State and has been placed on "foreign service" under that State. As a consequence the Bhopāl Traverse Detachment was disbanded on 1st March 1923.

(*g*) Two Survey detachments known as the Razmak and Waziristān Detachments were formed during the year for field service on the North-West Frontier. Of these the latter is still at work.

(*h*) A detachment was sent to carry out surveys for the Anglo-Persian Oil Company, Muhammareh, in October 1922 and after returning to India in July has been augmented and resumed its work in September 1923.

(*i*) The administrative control of the Imperial Standard Mapping Section was transferred from the Government of Bengal to the Survey of India from 1st August 1923.

(*j*) The centenary of the death on 20th January 1823 of Colonel W. Lambton, F.R.S., the founder of the Great Trigonometrical Survey, was celebrated in a befitting manner in the headquarter offices at Calcutta and Dehra Dūn.

(*k*) Dr. J. deGraaff Hunter, M.A., Sc.D., F. Inst. P., attended the meeting of the International Association of Geodesy and Geophysics in Rome in May 1922 as a British Empire delegate. He was appointed to serve on two committees dealing with telegraphic longitude and with the force and deflection of gravity.

(*l*) Much valuable geographical information was supplied to the department by the late Brigadier General G. Pereira, C.B., obtained during his journey from Peking through Tangar, Jyekundo and Lhāsa.

(*m*) The pay of Class II officers including those promoted to Class I was again revised.

(*n*) A competitive examination for the filling of 4 posts in the Class II Service was held during the year. 33 candidates were nominated by Selection Boards, held at the various Survey headquarters, to sit for the examination.

II.—ADMINISTRATION AND PERSONNEL.

6. The actual cost of the department for the financial year ending 31st March 1923 and of the two previous years is shown below:—

	1920-21.	1921-22.	1922-23.	REMARKS.
	Rs.	*Rs.*	*Rs.*	* Includes an unusual charge of over Rs. 9,00,000 debited to the department on account of Europe stores. † These figures are not final.
Gross actual cost ...	48,70,530	62,01,542*	53,89,494†	
Deduct receipts and credits	15,52,147	19,38,588	24,67,092†	
Net actual charges ...	33,18,383	42,62,954	29,22,402†	

7. Colonel C. H. D. Ryder, C.B., C.I.E., D.S.O., R.E., the extension of whose services had been sanctioned by His Majesty's Secretary of State for India, administered the department throughout the year.

8. Of Class I officers:—Colonel H. L. Crosthwait, C.I.E., R.E., and Messrs. J. H. Nichol and O. C. Ollenbach retired, Captains J. K. Douglas, R.E., R. S. P. MacIvor, I.A., T. W. R. Hayeraft, R.E., and G. W. Gemmell, I.A., reverted to military duty.

Lieutenant H. A. Bazley, R.E., has been deputed temporarily to military duty to attend the Supplementary Course for R. E. Officers at Chatham and Cambridge.

Messrs. C. E. C. French and C. C. Byrne were promoted temporarily from the Class II Service.

Mr. A. Lacamp was appointed as Assistant Manager, Mathematical Instrument Office.

Of Class II officers:—Mr. H. G. Shaw ceased to be re-employed, Khan Bahadur Haji Abdul Rahim retired, Mr. O. J. H. Hart was drowned at Amherst, Captain W. J. B. Miller who was on military duty retired from 22nd September 1921, having been invalided by the Medical Board, India Office, Mr. T. O. Threlfall, probationer, resigned.

Mr. C. H. G. Johnson was transferred permanently under the Government of the Central Provinces.

Mr. N. N. Chuckerbutty, L.C.E., was transferred for employment in the Thomason College, Roorkee.

Messrs. J. McCraken, M.B.E., and A. F. Murphy were placed on foreign service with the Anglo-Persian Oil Company.

Messrs. B. M. Berrill and P. Simpson reverted from deputation under the Governments of Bombay and Bihār and Orissa respectively.

In the Upper Subordinate Service, Mr. Damodar Khadilkar retired, and 3 probationers resigned, Messrs. Sher Jang, K.B., and Sijawal Khan were placed on foreign service with the Anglo-Persian Oil Company and Messrs. Chuni Lal Kapur and Vidya Dhar Chopra with the Bhopāl State. 3 officers were promoted from the Lower Subordinate Service.

The total strength of the department at the close of the Survey year was 55 Class I, 91 Class II and 81 Upper Subordinate officers besides specialists, clerks, lower subordinates and menials

9. With a view to economy, No. 16 (Tidal) Party and the Computing Office, Dehra Dūn, have been temporarily amalgamated with effect from the 1st April 1923, the combined party being designated "Computing and 16 (Tidal) Party".

The Training Section of the Southern Circle was disbanded on the 16th October 1922.

No. 20 (Cantonment) Party has been placed under the administrative control of the Superintendent of the Trigonometrical Survey from the 1st April 1923.

Nos. 10, 11 and 21 Parties were transferred to the administrative control of the Superintendent, Burma Circle, on the 11th April 1923.

10. The following honour was conferred during the year:—

Back Memorial of the Royal Geographical Society.	Mr. Sher Jang, Khan Bahadur, Sub-Assistant Superintendent.

PART 2.—WORK OF FIELD PARTIES, &c.

I.—TOPOGRAPHICAL SURVEYS.

11. The two following tables show respectively the progress of the topographical programme assigned to the department in 1905 and the out-turns and costs of different parties during the year under report. They are followed by brief descriptions of the work of each topographical party.

In 1913, the Secretary of State sanctioned a scheme for the reduction of the scale of survey of certain sparsely populated areas of India. This will greatly reduce the area of survey on the one-inch scale and consequently accelerate the rate of progress of topographical surveys shown in Table I below. In order to give a better idea of what work actually lies before the department, it may be remarked that of the area remaining for survey about 533,200 square miles are likely to be surveyed on the half-inch or smaller scales.

Table I.—Progress of Topographical Surveys since 1905.

Survey year.	Scales of Survey.	Northern Circle.	Southern Circle.	Eastern Circle.	Burma Circle.	TOTALS.
		Sq. miles.	*Sq. miles.*	*Sq. miles.*	*Sq. miles.*	*Sq. miles.*
1905-12	Mostly 2-inch and 1-inch.	122,164	66,961†	20,147†	52,610†	261,882†
1912-13	Mostly 1-inch and ½-inch.	28,192	13,349	7,404	4,432	53,377
1913-14	ditto.	25,052	15,844	7,291	7,599	55,786
1914-15	ditto.	12,334	19,286	2,448	2,608	36,676
1915-16	ditto.	8,168	17,243	2,279	4,652	32,342
1916-17	ditto.	11,689	11,338	3,560	6,163	32,750
1917-18	ditto.	4,202	12,181	3,596	4,800	24,779
1918-19	ditto.	509	7,268	1,764	4,412	13,948
1919-20	ditto.	9,145	11,891	4,311	5,117	30,464
1920-21	ditto.	14,411	14,275	5,766	5,509	39,961
1921-22	ditto.	11,528	21,596	5,970	5,510	44,604
1922-23	ditto.	26,199	20,823	9,144	5,482*	61,648
Total areas completed to date.		**273,593**	**232,050**	**73,680**	**108,894**	**688,217**
Approximate areas for the whole topographical programme.		**750,000**	**542,800**	**262,925**	**265,875**	**1,821,600**
Approximate areas remaining for survey.		**476,407**	**310,750**	**189,245**	**156,981**	**1,133,383**

* Excludes 3 square miles surveyed on two-inch and larger scales, and 6 square miles previously reported in 1905-06.

† Areas reported in General Report for 1921-22 have been corrected in some cases.

Table II.—OUT-TURNS of PLANE-TABLING and COSTS of Topographical Surveys, 1922-23.

Party and Locality. Character of Country.	Scale and Class of Survey.	Out-turns of Plane-tabling. Areas on each Scale of each Class. (Sq. miles)	Out-turns of Plane-tabling. Totals of areas on all Scales. (Sq. miles)	Costs of Survey including Mapping. Total Costs. (Rs.)	Costs of Survey including Mapping. Cost-rates. (Rs. per sq. mile.)	Remarks.
No. 1 Party—*Baluchistān, Punjab and Punjab States.*						**NORTHERN CIRCLE.**
Hills, bare, precipitous and waterless	**Half-inch** Original Survey ...	1,458				
Ditto	**One-inch** Original Survey ...	164				
Riverain plains, wooded and cultivated.	**One-inch** Original Survey ...	435	4,938	1,04,350 (a)	21·1	(a) Includes cost of training pupils and probationers.
Ditto	**One-inch** Revision Survey ...	352				
Plains, open sandy waste partly cultivated and intermixed with dense scrub.	**One-inch** Revision Survey ...	2,529				
No. 2 Party—*Central India, Gwalior, Rājputāna and United Provinces.*						
Jungle-clad hills and cultivated plains.	**Half-inch** Original Survey ...	6,368				
Cultivated plains	... **One-inch** Resurvey ...	564	9,612	1,36,618 (b)	14·2	(b) Excludes Rs. 12,555 cost of training soldier surveyors and pupils; Rs. 230 debitable to Mussoorie Municipality area and Rs. 14 to Western Jumna Canal.
Ditto	... **One-inch** Revision Survey ...	2,680				
No. 3 Party—*United Provinces and Rājputāna.*						
Open and thinly wooded hills	... **Two-inch** Original Survey ...	261				
Ditto	... **Two-inch** Supplementary Survey	48				
Cultivated plains, moderately open	**One-inch** Resurvey ...	1,584	5,200	88,278 (c)	17·0	(c) Excludes cost of arrears fair-mapping and mapping of the work of the Razmak Detachment and ½-inch survey of season 1923-24 commenced in September 1923.
Open and thinly wooded hills	... **Half-inch** Original Survey ...	417				
Sparsely populated sand dunes	... **Quarter-inch** Original Survey...	2,890				
No. 4 Party—*United Provinces and Bihār & Orissa.*						
Cultivated plains, congested with villages and low hills densely wooded.	**One-inch** Revision Survey ...	6,449	6,449	1,08,812 (d)	16·9	(d) Excludes Rs. 349 cost of demarcating the Pāra-Basantpur village boundary in the United Provinces and Rs. 11,740 for the training of probationers and pupils.
TOTALS, NORTHERN CIRCLE:—		26,199 sq. m.		Rs. 4,38,058		Cost-rate 16·7

Table II.—OUT-TURNS of PLANE-TABLING and COSTS of Topographical Surveys, 1922-23.

Party and Locality. Character of Country.	Scale and Class of Survey.	Out-turns of Plane-tabling. Areas on each Scale of each Class. (Sq. miles.)	Out-turns of Plane-tabling. Totals of areas on all Scales. (Sq. miles.)	Costs of Survey including Mapping. Total Costs. (Rs.)	Costs of Survey including Mapping. Cost-rates. (Rs. per sq. mile.)	Remarks.
No. 5 Party—*Central India and Gwalior.*						**SOUTHERN CIRCLE.**
Open plains and densely wooded plateau and hills.	**Half-inch** Original Survey ...	3,235	4,406	1,35,287	30·7	*(e)* Includes 372 square miles of Indore State forests and 115·353 square miles of Dhār State forest.
	One-inch Original Survey ...	(e)1,171				
No. 6 Party—*Hyderābād.*						
Undulating and cultivated country: wooded hills.	**Half-inch** Original Survey ...	2,474	3,292	1,28,389	39·0	
	Two-inch Original Forest Survey	818				
No. 7 Party—*Madras and Mysore.*						
Undulating, rather intricate, undulating with isolated hills, low hills, jungle-clad.	**One-inch** Original Survey ...	4,256	6,330	1,35,465	21·4	
	One-inch Resurvey ...	1,394				
	One-inch Revision Survey ...	680				
No. 8 Party—*Bombay Presidency, Hyderābād State and Portuguese India.*						
Low lying wooded areas in Goa and Sāvantvādi State, portions of the Western Ghāts, and open and cultivated plains of the Bombay Deccan and Hyderābād State.	**One-inch** Revision Survey ...	6,489	6,795	1,44,194 *f)*	21·2	*(f)* Includes cost of fair-mapping and fixing scattered auxiliary heights.
	One-inch Revision Survey ...	133				
	One-inch Resurvey ...	173				
TOTALS, SOUTHERN CIRCLE:—		**20,823**	**sq. m.**	**Rs. 5,43,335**	**Cost-rate 26·1**	

Table II.—OUT-TURNS of PLANE-TABLING and COSTS of Topographical Surveys, 1922-23.

Party and Locality. Character of Country.	Scale and Class of Survey.	Out-turns of Plane-tabling. Areas on each Scale of each Class. (Sq. miles.)	Out-turns of Plane-tabling. Totals of areas on all Scales. (Sq. miles.)	Costs of Survey including Mapping. Total Costs. (Rs.)	Costs of Survey including Mapping. Cost-rates. (Rs. per sq. mile.)	Remarks.
						EASTERN CIRCLE.
No. 9 Party—*Bengal and Bihār & Orissa.*						
Cultivated plains, well populated, some flat some undulating, varied with rocky scrub covered hills.	**One-inch** Original Survey ...	893	3,684	1,74,289	47·3	
	One-inch Supplementary Survey	2,791				
No. 12 Party—*Assam.*						
Low hills jungle-clad ...	**One-inch** Original Survey ...	499	5,460	1,86,183	34·1	
Mainly hills, partly open, partly jungle-clad and plains cultivated and open.	**Half-inch** Original Survey ...	4,961				
TOTALS, EASTERN CIRCLE:— 9,144 sq. m. Rs. 3,60,472 Cost-rate 39·4						

Table II.—OUT-TURNS of PLANE-TABLING and COSTS of Topographical Surveys, 1922-23.

Party and Locality Character of Country. Scale and Class of Survey.	Out-turns of Plane-tabling. Areas on each Scale of each Class.	Out-turns of Plane-tabling. Totals of areas on all Scales.	Costs of Survey including Mapping. Total Costs.	Costs of Survey including Mapping. Cost-rates.	Remark.
	Sq. miles.		*Rs.*	*Rs. per sq. mile.*	
No. 10 Party—*Upper Burma.*					**BURMA CIRCLE.**
Densely wooded hills ... **Half-inch** Original Survey ...	1,957	2,225	1,48,919 (*g*)	66·9	(*g*) Excludes Rs. 13,920 being cost of Maymyo Drawing Office employed on half-inch compilation and mapping.
Ditto ... ... **One-inch** Original Survey ...	268				
No. 11 Party—*Lower Burma.*					
High hills and low ground densely wooded. **One-inch** Original Survey ...	1,593	2,679	1,93,812 (*h*)	72·3	(*h*) Includes Rs. 7,649 cost of forest surveys debitable to Forest Department, Burma, excludes Rs. 693 part cost of survey of Maymyo Residential Area debitable to Public Works Department, and Rs. 2,703 cost of Maymyo Drawing Office.
High densely wooded hills, and cultivated undulating plains mixed with forest growth. **One-inch** Supplementary Survey	1,021				
Hills densely wooded ... **Two-inch** Original Survey ...	55				
Flat undulating ground densely wooded. **Four-inch** Original Survey ...	10				
No. 21 (Burma Forest) Party—*Lower Burma.*					
Densely wooded hills and plains **Two-inch** Original Survey ...	584	587	1,72,800	294·4	(*i*) Also surveyed on the 2-inch scale.
Mostly **Four-inch** and larger scales Original Survey of exclusions.	3 (*i*)				
TOTALS, BURMA CIRCLE:— 5,491 sq. m. Rs. 5,15,531 Cost-rate 93·9					
GRAND TOTALS:—61,657 sq. m. Rs. 18,57,396 Cost-rate 30·1					

NORTHERN CIRCLE (*vide* Index map No. 1).

SUPERINTENDENT { Lieut.-Colonel H. Wood, R.E., up to 21st Aug. 1923. / Lieut.-Colonel E.A. Tandy, R.E., from 22nd Aug. 1923.

12. No. 1 Party.—The programme comprised the survey on the half-inch scale of the south-eastern portion of the Sulaimān range, which here divides Baluchistān from the Punjab; and, on the one-inch scale, the country extending eastwards from the hills to the Indus river. In addition to the above an overlap of 211 square miles was surveyed, to secure proper junction between the one-inch and half-inch mapping in the west for current work and in the east, along the Indus river, for future publication.

PERSONNEL.
Class I Officer.
Mr. C. C. Byrne, in charge.
Class II Officers.
Major C. H. Tresham.
Mr. O. D. Jackson.
Upper Subordinate Service.
9 Officers.
Lower Subordinate Service.
22 Surveyors, etc.

The area covered by the half-inch survey lies partly in Baluchistān and partly in the Punjab; it consists of 1,458 square miles of bare, precipitous hills rising from about 300 to about 4,500 feet above mean sea level. The country is uninhabitable, water is scarce and everywhere brackish—in most places it is undrinkable—and, owing to the very broken nature of the ground, communications are few and difficult. This area is nominally occupied by the Marri-Bugti tribes of Baluchistān in the west and in the east by the Mazārī, Drishak, Gurchānī, Laghārī, and Tibbi Lund sections of the Rind-Baluch tribes in the Dera Ghāzi Khān district of the Punjab.

The area surveyed on the one-inch scale comprises the southern half of the Dera Ghāzi Khan district and small portions of the Muzaffargarh district and of Bahāwalpur State. The country may conveniently be described as :—

(1) The Sind, or riverain, lands along the Indus (Sind) river which are irrigated both by wells and canals, closely cultivated and densely populated; being washed annually during the monsoon by the overflow of the Indus, many portions are covered with dense scrub, reeds and tall grass; the cultivated portions are well covered with trees, particularly along the canal banks, so that distant views are not obtainable.

(2) The Pachād or arid zone, lying between the hills and the Indus, is formed from loam brought down by the hill torrents during the rains. The soil of this region is very rich and is cultivated wherever water is obtainable, but such spots are comparatively few; the ground is mostly covered with dense 'jāl' jungle which provides excellent fodder for camels, and large herds of these are annually brought in from the adjoining districts to graze. The wells in this area generally contain brackish water.

13. No. 2 Party.—This party surveyed an area of 2,558 square miles in the Āgra, Jālaun, Jhānsi, Hamirpur and Bāndā districts of the United Provinces; 56 square miles in Bharatpur State and 274 square miles in Dholpur State in Rājputāna, 28 square miles in Gwalior State, and 328 square miles in Bānkā-Pahārī, Baonī, Berī, Charkhārī, Datiā, Dhurwai, Jignī, Orchhā, Samthar, Sarīla, and Tori-Fatehpur States of the Bundelkhand Agency in Central India on the one-inch scale; and 17 square miles in Jālaun district of the United Provinces, 377 square miles in Bharatpur State, 211 square miles in Jaipur State, 641 square miles in Karauli State, and 762 square miles in Dholpur State all in Rājputāna, and 4,155 square miles in Gwalior State, 18 square miles in Indore State, and 187 square miles in Datiā State both the latter in the Bundelkhand Agency on the half-inch scale. The area surveyed on the one-inch scale included 15 square miles of Reserved Forest (*vide* page 20).

PERSONNEL.

Class I Officers.

Bt.-Lieut.-Colonel S. W. S. Hamilton, D.S.O., R.E., in charge from 1st November 1922.

Captain L. H. Jackson, I.A., in charge to 31st October 1922.

Class II Officers.

Mr. P. A. T. Kenny, O.B.E.
,, Duni Chand Puri
,, Prafulla Kumar Ghosh, B.Sc., F.R.G.S.

Upper Subordinate Service.

4 Officers.

Lower Subordinate Service.

57 Surveyors, etc.

The country surveyed on the one-inch scale consisted of cultivated plains, open and easy. Half the area on the half-inch scale was similarly open and the remainder consisted of ranges of hills mostly covered with long grass and dense thorn jungle. There was a great deal of broken ground deeply cleft along the banks of the Chambal river and also along the Betwā and Dhasān rivers though less rugged.

Triangulation and traversing was carried out in Jaipur, Karauli, Tonk, Būndi, Kotah and Gwalior States and in the Bundelkhand Agency and areas of 7,600 and 3,650 square miles respectively completed in advance for detail survey on the half-inch scale.

14. No. 3 Party.—This party surveyed an area of 309 square miles on the two-inch scale in the Dehra Dūn and Garhwāl districts, 1,584 square miles on the one-inch scale in the Naini Tāl, Pilībhīt, Kherī and Shāhjahānpur districts and 417 square miles on the half-inch scale in Tehrī State in the United Provinces. Also an area of 2,890 square miles on the quarter-inch scale in the unsurveyed portions of Mārwār and Jaisalmer States in Rājputāna.

PERSONNEL.

Class I Officers.

Major C. G. Lewis, R.E., in charge.
Captain T. W. B. Haycraft, R.E.
„ W. J. Norman, M.C., R.E.

Class II Officers.

Mr. J. C. C. Lears.
„ L. Williams, M.B.E.
„ J. H. Johnson.
„ A. J. A. Drake, D.C.M.

Upper Subordinate Service.

2 Officers.

Lower Subordinate Service.

26 Surveyors, etc.

The two-inch survey in Kumaun and Garhwāl has been executed chiefly in the interests of the Forest Department and the survey of nine-tenths of the reserved forests of the Kumaun Forest Circle has been carried out during the past eight years.

The triangulation necessary for the survey in Rājputāna was carried out *pari passu* with the quarter-inch detail survey.

15. No. 4 Party.—Survey operations were continued in the United Provinces and Bihār & Orissa on the one-inch scale, an area of 1,050 square miles being surveyed in Shāhābād district of Bihār & Orissa and 5,083 square miles in Azamgarh, Ballia, Benares, Ghāzīpur, Jaunpur, Mirzāpur and Sultānpur districts and 316 square miles in Benares State, of the United Provinces, or a total of 6,449 square miles. In addition, an area of 470 square miles was triangulated in the Mirzāpur and Shāhābād districts and Benares State to supply data for the detail survey during the current season.

PERSONNEL.

Class I Officers.

Mr. M. C. Petters, in charge to 4th November 1922 and from 5th March 1923.

Captain L. H. Jackson, I.A., in charge from 5th November 1922 to 4th March 1923.

Class II Officers.

Major J. H. Williams.
Mr. L. Williams, M.B.E.
„ G. A. Norman, M.B.E.
Lieut. C. S. McInnes.
Mr. Abdul Karim, B.A.
„ Moqimuddin, B.A.
„ Muhammad Aslam Chowdhury, B.A. *(on probation).*

Upper Subordinate Service.

4 Officers.

Lower Subordinate Service.

44 Surveyors, etc.

The country surveyed consists mainly of well cultivated plains dotted over with numerous lakes, marshes and groves of mango trees and intersected by several rivers the principal of which are the Ganges, Gumtī and Karamnāsā. In the Chakiā district of Benares State and in Mirzāpur, the country begins to undulate and the alluvial plain gives place to a hilly region densely wooded which forms the northern slopes of the Kaimur range.

A report on the deputation of an officer in connection with the disputed boundary between Pāra and Basantpur villages lying in Bāra Banki and Gondā districts, respectively, will be found on page 58.

16. Training.—No pupil surveyors were entertained during the year. Of those entertained in 1920 and 1921, 10 were promoted unclassified surveyors, and 4 were discharged.

No soldier surveyors joined for training during the year. Of the number reported as undergoing training last year, 2 have been reverted to their regiments, and, of the remainder, 3 are undergoing their 2nd period of training, 3 having been permanently transferred to the Survey of India.

17. Recess Work.—The fair-mapping of sheets of the previous and current seasons' survey, was completed by 30th September 1923, with the exception of the following:—

Sheets on the one-inch scale	9
Sheets on the half-inch scale	3
Sheets on the quarter-inch scale	1
Environs map of Lucknow	1

Of these, 2 of the half-inch sheets and the Environs map were delayed owing to some of the boundaries on them being under reference. All these sheets will be submitted for publication before the commencement of the next recess season.

18. Record Section.—This section which was formed during the year 1919-20 has now been amalgamated with No. 3 Drawing Office, and the work done by it will be found on page 53.

19. Particulars of work done by Nos. 22 and 23 Parties will be found on pages 58 and 59.

SOUTHERN CIRCLE (*vide* Index map No. 1).

SUPERINTENDENT { Lt.-Col. C. P. Gunter, O.B.E., R.E., up to 2nd January 1923. Lt.-Col. G. A. Beazeley, D.S.O., R.E., from 3rd January 1923.

20. No. 5 Party.—This party surveyed an area of 4,406 square miles as follows:—343 square miles in Indore State, 1,069 square miles in Dhār State, 2 square miles in Jhābua State, 78 square miles in Nimkhera State, 95 square miles in Barwāni State, 238 square miles in Dewās State, 3 square miles in Jāmnia State, 289 square miles in Bhopāl State, and 19 square miles of "disputed" territory, all of the Central India

PERSONNEL.

Class I Officers.

Major F. B. Scott, I.A., in charge.
Captain G. Lennox, I.A.

Class II Officers.

Mr. J. H. S. Wilson.
" F. C. Pilcher.
" Muhammad Najamuddin, B.A.

Upper Subordinate Service.

4 Officers.

Lower Subordinate Service.

33 Surveyors, etc.

Agency, 1,099 square miles in the Amjhera and Ujjain districts of Gwalior on the half-inch scale; 858 square miles in Indore State, 152 square miles in Dhār State, and 104 square miles in Bhopāl State, all of the Central India Agency, 57 square miles in the Amjhera and Ujjain districts of Gwalior, on the one-inch scale.

The country surveyed consists of well cultivated plains and jungle-clad hills.

It also triangulated an area of 1,810 square miles in the Central Provinces.

21. No. 6 Party.—This party completed an area of 2,474 square miles of half-inch original survey and 818 square miles of two-inch original survey in the Raichūr, Mahbūbnagar and Nalgonda districts of Hyderābād.

PERSONNEL.

Class I Officers.

Major R. S. Wauchope, O.B.E., I.A., in charge from 26th April 1923.

Captain J. K. Douglas, R.E., in charge to 25th April 1923.

Class II Officers.

Mr. E. A. Meyer.
" J. C. St. C. Pollett.
" E. N. Natesan, B.A.

Upper Subordinate Service.

4 Officers.

Lower Subordinate Service.

25 Surveyors, etc.

An area of 200 square miles of supplementary triangulation was completed in the Nalgonda district and of 1,120 square miles of triangulation for half-inch surveys in the Warangal district of Hyderābād.

22 linear miles of theodolite traversing through forest areas were completed.

The country surveyed is undulating and generally cultivated except in the wooded hills of the forest areas.

22. No. 7 Party.—This party surveyed an area of 4,936 square miles on the one-inch scale in the Cuddapah, Anantapur and Chittoor districts of Madras and 1,394 square miles on one-inch scale in the Kolār district of Mysore. It triangulated an area of 5,502 square miles in the Anantapur and Bellary districts of Madras and the Kolār and Tumkūr districts of Mysore.

PERSONNEL.

Class I Officers.

Major J. D. Campbell, D.S.O., R.E., in charge to 8th May 1923.

Captain G. W. Gemmell, I.A.

Class II Officers.

Mr. S. S. McA'Fee Fielding, in charge from 9th May 1923.

Mr. V. W. Morton.
" A. F. Murphy.
" N. S. Harihara Iyer.
" C. P. E. Davenport.

Upper Subordinate Service.

5 Officers.

Lower Subordinate Service.

38 Surveyors, etc.

The country surveyed was, in parts, hilly and intricate, and in others undulating, rather densely populated and generally presented no real difficulties.

23. No. 8 Party.—This party surveyed 6,795 square miles on the one-inch scale. Of this area 173 square miles fell in the Portuguese territory of Goa, 133 square miles in Hyderābād State, 181 square miles in Sāvantvādi State, 7 square miles in Kolhāpur State, 229 square miles in the Southern Marāthā Jāgīrs and the balance of 6,072 square miles in the Ahmadnagar, Poona, Sholāpur, Belgaum, Dhārwār and North Kanara districts of the Bombay Presidency.

PERSONNEL.

Class I Officer.

Lieut.-Colonel M. O'C. Tandy, D.S.O., O.B.E., R.E., in charge.

Class II Officers.

Mr. M. Mahadeva Mudaliar, M.A.
,, B. T. Wyatt.
,, M. S. Ganesa Aiyar.
,, Srinivasa Rao Kelkar, B.Sc.

Upper Subordinate Service.

4 Officers.

Lower Subordinate Service.

44 Surveyors, etc.

Except for the low lying and wooded areas of Goa and Sāvantvādi State and the portions of the Western Ghāts between these areas and Belgaum district, the country surveyed consisted of the open and cultivated plains of the Bombay Deccan. The towns and cantonments of Ahmadnagar and Belgaum were included in the area surveyed.

The survey of the country near Belgaum was undertaken at the special request of the military authorities and was mapped on the half-inch scale in advance of the one-inch sheets.

24. Instruction in Triangulation.—A class was formed before the close of the recess season for the instruction of officers and surveyors in the handling of theodolites and in triangulation and its computations.

2 Class II officers, 3 Upper Subordinate officers and 8 surveyors received instruction. The field work was carried out in the neighbourhood of Bangalore.

Of these 1 Class II officer, 2 Upper Subordinate officers and 1 surveyor will carry out triangulation in the field under the superintendence of the Officer in charge No. 6 Party during the coming field season.

25. Miscellaneous.—Nos. 5, 6, 7 and 8 Parties, Circle Office and No. 4 Drawing Office were inspected by the Surveyor General in August and September 1923.

Nos. 5, 6, 7 and 8 Parties were inspected once in the field and on several occasions during recess by the Superintendent, Southern Circle.

26. Recess Work.—9 one-inch sheets out of 46 surveyed during the year and 1 one-inch sheet previously surveyed and partly resurveyed during the year were submitted to the circle office before the 30th September 1923. All the remaining sheets will be fair-mapped before the close of the recess season. The publication of 1 one-inch

sheet, previously surveyed and which was submitted for publication during the year has been held up as the sheet requires a small amount of revision in the field; with this exception there are no arrears of mapping from the previous season's work.

2 original half-inch sheets out of 7 surveyed during the year were submitted to the circle office before the 30th September 1923. The remaining 5 sheets will be fair-mapped before the close of the recess season. There are no arrears of mapping from the previous season's work.

Besides the above, 13 out of 19 special forest maps being fair-mapped by Nos. 5 and 6 Parties were submitted to the circle office before the 30th September 1923. Of the remaining 6 sheets, 4 will be fair-mapped before the close of the recess season, 1 sheet requires a small amount of revision in the field and the publication of another sheet is being withheld till it can be completed up to margin from two-inch surveys to be carried out during next field season. There are no arrears of mapping from the previous season's work.

27. Record Section.—This section which was formed on the 1st May 1921 was amalgamated with No. 4 Drawing Office from the 15th June 1923 and has been reported on under *Triangulation charts and computations* on page 54 of this report.

EASTERN CIRCLE (*vide* Index map No. 1).

SUPERINTENDENT—Colonel W. M. Coldstream, R.E.

28. No. 9 Party.—This party surveyed an area of 3,684 square miles on the one-inch scale in the provinces of Bengal and Bihār and Orissa.

PERSONNEL.

Class I Officers.

Bt.-Lieut.-Colonel R. H. Phillimore, D.S.O., R.E., in charge.
Captain R. S. P. MacIvor, I.A.
Lieut. H. A. Bazley, R.E.

Class II Officers.

Mr. E. J. Biggie.
,, Amar Krishna Mitra.
Lieut. C. S. McInnes.
Captain J. O'C. Fitzpatrick.
Mr. Bhupendra Nath Saha, M.Sc.

Upper Subordinate Service.

4 Officers.

Lower Subordinate Service.

37 Surveyors, etc.

The work fell in the districts of 24 Parganas, Bīrbhūm, Murshidābād, and Mālda in Bengal and in the districts of Santāl Parganas, Shāhābād, Sāran, Muzaffarpur and Patna in Bihār and Orissa.

The area surveyed in Bengal covered Sāgar Island at the mouth of the Hooghly river, and also an area lying between the loop line of the East Indian Railway and the Bhāgirathi river; both areas were flat and thickly populated.

The area surveyed in Bihār was flat and thickly populated in the neighbourhood of Patna, where it included the towns of Patna, Bankipore, Dinapore and Sonpur. The portion that lay in the Santāl Parganas was partly open and undulating and partly steep rocky hills covered with scrub jungle.

An area of 2,970 square miles was triangulated for one-inch survey in the Orissa Tributary States.

An area of 820 square miles was triangulated and traversed for four-inch survey covering the Rāniganj Coalfield in the districts of Burdwān, Bānkurā, Birbhūm and Santāl Parganas.

29. No. 12 Party.—This party surveyed an area of 5,460 square miles on the one-inch and half-inch scales in Assam, in the districts of Cāchār, Nowgong, Sibsāgar, Nāgā Hills and in Manipur State.

PERSONNEL.

Class I Officers.

Lieut.-Colonel C. M. Browne, C.M.G., D.S.O., R.E., in charge.
Captain H. R. C. Meade, I.A.

Class II Officers.

Mr. E. M. Kenny.
,, D. K. Rennick, M.B.E.
,, R. C. Hanson.

Upper Subordinate Service.

4 Officers.

Lower Subordinate Service.

40 Surveyors, etc.

310 linear miles of traversing, covering an area of 1,066 square miles, were carried out in Sadiyā Frontier Tract in advance of the detail survey.

The area surveyed was mostly hilly, ranging from 400 to about 9,000 feet; a large portion of it was covered with dense forest.

30. Training.—Six pupil surveyors were engaged in November 1922 and were under instruction in the field; they completed an average of 30 square miles each during the season, and are all likely to become useful surveyors.

Three more pupils were entertained in June 1923 and sent to No. 21 Party in Burma after 3 months' instruction in the neighbourhood of Shillong.

31. Recess Work.—Since the formation of a separate administrative circle for Burma in April, the Burma parties no longer submit their sheets to the Superintendent, Eastern Circle. Twenty-three sheets were surveyed by the other parties, of which 12 have been received in the circle office. The 11 remaining sheets are expected in November.

In the circle office, all professional records have been re-arranged and their storage and registration systematised. The transfer of records appertaining to Burma has involved a good deal of work which is now completed.

The Burma half-inch and quarter-inch mapping in hand in No. 5 Drawing Office when the new circle was formed has been finished and, except under special arrangements, no more will be undertaken.

Captain Meade and two draftsmen were engaged for 3 months of the recess season in compiling and adjusting the photo-survey carried out by the former in Bhutān and S. Tibet in 1922, and completing the four quarter-inch field sheets for fair-mapping.

BURMA CIRCLE (*vide* Index map No. 1).

SUPERINTENDENT—Lt.-Col. C. P. Gunter, O.B.E., R.E., from 11th April 1923.

32. No. 10 Party.—This party surveyed an area of 2,052 square miles on the half-inch and one-inch scales in the Myitkyina and Upper Chindwin districts of Burma and the adjoining tribal territory and 173 square miles on the half-inch scale in the tribal territory between the Mali Hka and Nmai Hka branches of the Irrawaddy, locally known as "The Triangle". The whole area surveyed is covered with dense jungle and consists of steep and intricate hills rising to 8,000 feet.

PERSONNEL.

Class I Officers.

Lieut.-Colonel E. T. Rich, C.I.E., R.E., in charge to 18th March 1923.
Captain O. Slater, M.C., R.E., in charge from 19th March 1923.

Class II Officers.

Mr. W. G. Jarbo.
" S. F. Norman.
Lieut. L. B. Fitz-Gibbon.
Mr. F. J. Grice.
" H. H. Creed.

Upper Subordinate Service.

4 Officers.

Lower Subordinate Service.

19 Surveyors, etc.

An area of 3,500 square miles in the Akyab, Minbu and Kyaukpyu districts of Burma was also triangulated in advance for topographical surveys. Except for a deltaic area which is highly cultivated and has numerous tidal creeks, the whole area is hilly and rises to 5,600 feet on the Arakan Yoma range. The western spurs of this range are covered with a single-stemmed bamboo but the higher ridges have a mixed forest growth. The ridges, which mainly run north and south, form in the sea area numerous wooded islands usually fringed with mangrove swamps.

33. No. 11 Party.—This party continued survey operations in the Amherst district of Lower Burma. The total area surveyed on all scales was 2,679 square miles made up of 1,593 square miles original and 1,021 square miles supplementary surveys, on the one-inch scale; 55 square miles of Reserved Forests on the two-inch

PERSONNEL.

Class I Officers.

Mr. J. O. Greiff, in charge.
Captain T. M. M. Penney, R.E.

Class II Officers.

Mr. O. J. H. Hart.
" G. E. R. Cooper.
" A. V. Dickson.

Upper Subordinate Service.

2 Officers.

Lower Subordinate Service.

30 Surveyors, etc.

scale; and 10 square miles on the four-inch scale. For the next season's programme an area of 2,180 square miles was triangulated.

The country surveyed extended from the southern confines of the district to north of the old town of Amherst on the sea coast. It is intersected by the low Taungnyo chain of hills which take off from the Sadaik peak, 3,080 feet high, in the south-east, on the main range separating Burma from Siam, and extend in a north-westerly direction to Moulmein, and form the western watershed of the Ataran river. Except for a narrow coastal strip, and the alluvial plains along the lower course of the Ataran, the whole of this tract is cut up by numerous streams and is densely wooded. It contains the Ataran group of Reserved Forests.

34. No. 21 (Burma Forest) Party.—The work done by this party is included in that shown under Forest Surveys, Burma Circle, pages 21 to 23.

The area over which operations extended consists of densely wooded hills and plains.

PERSONNEL.

Class I Officer.

Mr. H. W. Biggie, in charge.

Class II Officers.

Lieut. L. B. Fitz-Gibbon.
Captain V. P. Wainright.
„ C. B. Sexton.
Mr. H. M. Critchell.

Upper Subordinate Service.

3 Officers.

Lower Subordinate Service.

35 Surveyors, etc.

35. Recess Work.—The sheets which had to be fair-mapped by the parties of the Burma Circle during the recess season numbered 32 including 17 special forest sheets. There was 1 two-inch sheet in arrears from the previous year's mapping which has now been completed. By the 30th September 7 of these sheets had been received in the circle office; all the remaining sheets will be received and sent for publication before the beginning of next recess season with the exception of 1 one-inch sheet which is not being drawn this recess as it requires to be examined in the field.

Two half-inch sheets already published had new survey carried out this year added to them. A new edition of these sheets will, however, not be published until the unsurveyed area is completed.

II.—FOREST SURVEYS.

36. Details of the topographical surveys of reserved forests executed by field parties of the Survey of India for the year under report, are given below. In the majority of cases, the surveys were carried out on the one-inch scale, but in special cases the four-inch, two-inch and half-inch scales were used. Boundary surveys were made where required, and plots prepared on the four-inch scale.

NORTHERN CIRCLE.

37. United Provinces. Western Forest Circle.—In order to complete sheet No. 53 J/8S., the greater part of which falls in the Kumaun Circle, the revision of parts of the old four-inch scale maps was carried out on the two-inch scale in the following Forest divisions:—

Dehra Dūn ...	...	...	...	9 square miles.
Lansdowne ...	...	...	...	28 „

Kumaun Forest Circle.—In the *South Garhwāl Forest Division*, an area of 25·5 square miles of reserved forests was surveyed on the two-inch scale, thus completing the forest surveys of this division. In order to avoid a change of scale, the intermediate non-forest areas up to the boundary of Tehri State were also surveyed on the two-inch scale.

Eastern Forest Circle.—In the *Jhānsi and Bāndā Forest Divisions*, reserved forest areas were surveyed on the one-inch scale as follows:—

				Area in square miles.
Jhānsi Division, Mau-Garauthā Range,				
Basneh block, No. 108 ...	...	...	...	2·0
Bāndā Division, Maudahā Range,				
Bandhur and Chilchta block ...		...	...	2·9
Kunchta block		...	...	4·5
	Total		...	9·4

Working Plan Circle.—In the *Afforestation Division*, the undermentioned reserved forest areas were surveyed on the one-inch scale:—

			Area in square miles.
Blocks Nos. 100 (Tharro), 101 and 102	...	...	1·3
Blocks Nos. 104, 105 (Moti Katra)	...	...	4·4
	Total	...	5·7

SOUTHERN CIRCLE.

38. Madras. II and III Forest Circles.—In the *Anantapur, West Cuddapah* and *Chittoor Forest Divisions,* an area of 328 square miles of reserved forests was surveyed on the one-inch scale.

EASTERN CIRCLE.

39. Assam. Western Forest Circle.—In the *Cāchār Forest Division* the survey of the remaining area of 99·84 square miles of the Langting Mupā reserved forest was completed on the one-inch scale.

Eastern Forest Circle.—In the *Nowgong Forest Division* the survey of the remaining areas of 93·27 (approx.) and 58·67 square miles of the reserved forests of Lumding and Kaki respectively was completed on the one-inch scale. The survey of the remaining area of 17·05 square miles of Intangki reserved forest of which an area of 72·61 square miles, surveyed on the half-inch scale last season, was not reported, was completed on the same scale.

In addition, Daldali and Dhansiri Extensions were surveyed before they were declared reserved forests, but as their boundaries are not settled, their areas are not reported.

BURMA CIRCLE.

40. Burma. Hlaing Forest Circle.—In the *Insein Forest Division* 65·1 linear miles of forest boundaries were traversed, and will be added to the Mahuya Reserve Blocks I and II for which old two-inch surveys will be drawn and published on the same scale.

Delta Forest Circle.—In the *Henzada Ma-ubin Forest Division* 294 linear miles of the boundaries of the undermentioned reserves were traversed:—

Padaw
Sinthe
Shwethanin
Kyaugin
Yenandaung
Kaingtha
Myinwadaung and Extensions
North Myanaung
South Myanaung and Extensions.

In the *Bassein Forest Division* 47 linear miles of the boundaries of the reserved forests of Myittaya, Sinhmon were traversed, and an area of 401·6 square miles of the undermentioned reserves surveyed on the two-inch scale :—

Chaungtha	Myittaya
Kungyaung	Sinma
Kyetpaung	Sinhmon
Mezali	Unclassed forest.
Thitpok	

In the *North Arakan Forest Division* an area of 20 square miles comprising Kunchaung Reserve was triangulated in advance for the purposes of two-inch survey.

Sittang Forest Circle.—In the *South Pegu Forest Division* 111 linear miles of forest boundaries were traversed and will be added to Aungmya, Kalein, Aseiktaung, Shanywagyi and Talaingma Reserves for which old two-inch surveys will be drawn and published on the same scale.

The Pyinbôngyi Extension Reserve was also traversed for future survey on the four-inch scale.

Tenasserim Forest Circle.—In the *Thaton Forest Division* an area of 130·6 square miles in the Wetwundaung, Bilin, Kyousein, Pabein, Danu, Kalamataung and Martaban Reserves was surveyed on the two-inch scale. In addition an area of 50·7 square miles of unclassed forest and cultivated land lying between the Kalamataung Reserve and the railway line to the west, was also surveyed on the same scale to show the main approaches to the reserve.

In the *South Tenasserim Forest Division* the survey of the remaining area of 51·7 square miles of the Heinze and Kaleinaung Reserve was completed on the two-inch scale.

In the *Ataran Forest Division* Ma-u No. 5 and Gwingyi No. II Extension Reserves comprising areas of 7·3 and 2·7 square miles respectively were surveyed on the four-inch scale. In addition to the above, areas previously surveyed on this scale as unclassed forest, and now included in the Dawebank, Ma-u No. VI Extension or Ye-le, Megwa No. III Extension, Natchaung No. I and II Extensions, Ma-u N. W., East and South Extensions and Inchaung and Kyatchaung Extensions were revised and brought up to date. The survey of part of the new addition to the Dawebank Reserve comprising an area of

4·3 square miles was commenced on the same scale, and subsequently altered to the one-inch, in accordance with instructions received from the Forest Department.

100 linear miles of traversing by chain and theodolite, comprising parts of the boundaries of different extensions, were completed.

Tinyu Reserve comprising an area of 2·8 square miles was surveyed on the two-inch scale.

The survey of 232 square miles on the one-inch scale of the proposed reserves of Anankwin and Sekangyi was completed. The areas covered by the proposed reserves of Lamaing and Alantaya were also surveyed on the one-inch scale, but not the boundaries, as these had not been demarcated. Such boundaries of the proposed reserves as have been surveyed can only be regarded as approximate, as they had not been completely demarcated on the ground at the time of survey.

III.—CANTONMENT AND LARGE SCALE SURVEYS.

41. No. 20 Party.—During the year the party completed the survey of Bareilly cantonment on the twelve-inch scale, and of the cantonments of Agra, Muttra, Sitāpur, Gorakhpur and Naini Tāl (Minor Cantonment) on the sixteen-inch scale. The bāzār areas in Bareilly and those of Agra, Muttra and Sitāpur were also surveyed on the forty-eight-inch and sixty-four-inch scales respectively.

PERSONNEL.
Class I Officer.
Mr. C. H. C. French, in charge.
Upper Subordinate Service.
1 Officer.
Lower Subordinate Service.
26 Surveyors, etc.

107·78 linear miles of traversing and 73·94 linear miles of levelling were also completed at a cost of Rs. 25·95 and Rs. 20·09 per linear mile respectively.

The fair-drawn originals of Secunderābād cantonment, the bāzār areas of Bangalore and a six-inch map of Deolāli and surrounding country have been submitted for publication.

The out-turn and cost-rates of the various surveys are as follows:—

Sixteen-inch original, 4,891·0 acres @ Rs. 1·63 per acre.

Sixteen-inch revision, 10,390·0 acres @ Rs. 1·07 per acre.

Twelve-inch revision, 4,835·0 acres @ Re. 0·76 per acre.

Forty-eight-inch revision, 66·0 acres @ Rs. 8·28 per acre.

Sixty-four-inch revision, 265·9 acres @ Rs. 28·61 per acre.

The total areas fair-drawn with cost-rates are as follows:—

7,630·00 acres on the sixteen-inch scale @ Re. 0·74 per acre.

85·00 acres on the sixty-four-inch scale @ Rs. 13·59 per acre.

20·11 square miles on the six-inch scale @ Rs. 106·41 per square mile.

379·00 acres on the one inch to fifty feet scale @ Rs. 11·82 per acre.

Alphabetical List of Cantonments and Military Stations surveyed and published up to the end of 1922-23.

(1) Agar Cantonment.
(2) Aurangābād do.
(3) Ahmadnagar do.
(4) Bakloh do.
(5) Balūn or Thath (Dalhousie) Camp area.
(6) Bannu Cantonment.
(7) Bellary do.
(8) Chaman do.
(9) Chitrāl Station.
(10) Dehra Dūn Cantonment.
(11) Deoli do.
(12) Drazinda Out Post.
(13) Drosh Cantonment.
(14) Delhi New do.
(15) Erinpura do.
(16) Fort Lockhart.
(17) Ghairat Station.
(18) Guna Cantonment.
(19) Hangu do.
(20) Hāpur (Bābūgarh) Remount Depôt.
(21) Hosūr Remount Depôt.
(22) Jandola Out Post.
(23) Jatta do.
(24) Jhelum Cantonment.
(25) Jullundur do.
(26) Jhānsi do.
(27) Kālka Cantonment.
(28) Kamptee do.
(29) Karāchi Port Trust (Manora).
(30) Landour Cantonment.
(31) Meerut do.
(32) Nasirābād do.
(33) Nimach do.
(34) Peshāwar do.
(35) Pallāvaram do.
(36) Poonamallee do.
(37) Quetta do.
(38) Quetta Fort.
(39) Quetta Civil Station.
(40) Rājkot Cantonment.
(41) Rāwalpindi do.
(42) Sahāranpur Remount Depôt.
(43) Sanāwar Cantonment.
(44) Saugor do.
(45) Sialkot do.
(46) Simla Indian Infantry Lines*
(47) Sitābaldī Fort (Nāgpur).
(48) Saint Thomas's Mount Cantt.
(49) Thal Cantonment.
(50) Topa do.
(51) West Hill do.
(52) Zām Out Post.

* Erroneously shown as "Agra Cantonment" on page 21 of the General Report for 1921-22.

ROYAL ASIATIC SOCIETY LIBRARY OF THE BOMBAY BRANCH OF THE

IV.—THE TRIGONOMETRICAL SURVEY.

SUPERINTENDENT—Lt.-Colonel H. McC. Cowie, R.E.

GEODETIC OPERATIONS.

42. No. 13 Party.—Astronomical, No. 14 Party.—Pendulum, No. 15 Party.—Triangulation, and No. 19 Party.—Base Line Operations.—No field operations were carried out by these four parties, the personnel being employed at the Headquarters offices of the Trigonometrical Survey.

PERSONNEL.

Class I Officers.

Dr. J. deGraaff Hunter, Sc.D., M.A., F. Inst. P., in charge from 19th February 1923.

Major C. M. Thompson, I.A., in charge to 18th February 1923.

Class II Officer.

Mr. D. H. Luxa.

Lower Subordinate Service.

16 Computers, etc.

43. No. 16 Party.—Tidal Operations.—Tidal registrations were carried out by means of self registering tide-gauges during the year at the following stations:—

Stations.	Date of commencement of observations.	Date of closing of observations.	Number of years of observations.	REMARKS.
1. Aden ...	1879 ...	Still working	44	
2. Karāchi ...	1868 ...	1880	*13 } 55	*With a small tide-gauge.
	1881 ...	Still working	42 }	
3. Bombay (Apollo Bandar).	1878 ...	"	45	
4. Bombay (Prince's Dock).	1888 ...	"	35	
5. Madras ...	1880 ...	1890	10 } 38	
	Restarted 1895	Still working	28 }	
6. Kidderpore ...	1881 ...	"	42	
7. Rangoon ...	1880 ...	"	43	
8. Moulmein ...	1880 ...	1886	6 } 20	
	Restarted 1909	Still working	14 }	
9. Port Blair ...	1880 ...	"	43	

In addition, the actual times and heights of high and low-water at Bhaunagar, Chittagong and Akyab were observed by watch and tide-pole, under the orders of the Port Officers concerned, and forwarded monthly to this office.

Hourly readings of the height of the water, on a tide-pole, were taken at Basrah throughout the day and night, and supplied weekly by the Director, Inland Water Transport, Mesopotamia. This arrangement was continued up to the 31st March 1922. Thereafter, the

diagrams taken by an automatic tide recorder, erected at Margil, were submitted by the Port Director, Basrah, up to the 30th April 1922, after which date, owing to very heavy silting during the floods, the tide recorder failed to function and was put out of action temporarily.

No further readings were received till the 2nd November 1922, since which date, the readings have been received regularly every week.

The observations for the year commencing 1st January 1922, were reduced by the method of harmonic analysis, and the constants thus deduced were used in the computation of data for the Basrah tide-tables for 1924.

Data for the prediction of tides for 1924 by the tide-predicting machine were computed for 40 ports. In addition the detail compilation of the tide-tables for the 9 riverain ports of India for 1924 was accomplished.

The tide predictions for the 1924 tide-tables for the Indian ports and Basrah, were effected by means of the tide-predicting machine at Dehra Dūn. The printing and publication of these tide-tables were carried out in the office of the Superintendent of the Trigonometrical Survey. Their issue to officers and the public is expected to be completed by about the end of October 1923. Advance copies, in manuscript form, of tables for the 1924 tides at the ports of Suez, Aden, Būshire, Bombay, Dublāt (Sāgar Island), Rangoon and Mergui, were prepared and despatched to the Hydrographer to the Admiralty in April 1923, and for the Hooghly river, to the Deputy Conservator of the Port of Calcutta and to Messrs. Thomas Cook and Son.

Tidal registrations at the nine working observatories have been carried out satisfactorily, and will be continued during the coming year. In addition, a new tide-gauge is to be installed at Bassein and, it is hoped, be in thorough working order before the end of 1923.

The tidal observatory at Prince's Dock (Bombay) is still being worked by the Port Authorities for their own purposes.

During the past year all these observatories, except Aden and Port Blair, were inspected.

44. The following table shows the annual and decadal percentages of errors in the predicted times and heights of high and low-water at the nine stations where observations have been taken by self-registering tide-gauges, from which it will be seen that the predictions for 1922 were as accurate as they have been in the past.

PERCENTAGE OF ERRORS IN PREDICTED TIMES AND HEIGHTS.

Year.	AT OPEN COAST STATIONS.						AT RIVERAIN STATIONS.					
	Number of Stations.	IN TIME.		IN HEIGHT.			Number of Stations.	IN TIME.		IN HEIGHT.		
		Within 15 minutes of actuals.		Within 8 inches of actuals.		Within 1/16 of mean range at springs.		Within 15 minutes of actuals.		Within 8 inches of actuals.		Within 1/16 of mean range at springs.
		H.W.—L.W.		H.W.—L.W.		H.W.—L.W.		H.W.—L.W.		H.W.—L.W.		H.W.—L.W.
1913	6	88	82	97	97	98	99	4	68	55	70	58	94	88
1914	6	77	79	96	97	98	98	3	75	67	71	55	92	84
1915	6	82	82	98	98	96	96	3	76	66	73	67	94	92
1916	6	81	82	96	97	96	99	3	81	68	73	62	93	87
1917	6	75	72	96	98	96	97	3	78	65	69	64	92	88
1918	6	83	82	97	97	97	96	3	76	63	66	65	90	89
1919	6	78	75	96	97	97	98	3	74	65	70	69	93	92
1920	6	82	81	94	97	97	98	3	76	66	64	62	89	86
1921	6	77	72	94	97	97	99	3	74	66	75	71	92	94
1922	5	81	75	97	98	96	97	3	73	66	71	73	92	95
Average of ten years.	...	80	78	96	97	97	98	...	75	65	70	65	92	90

45. *Tide-predicting machine.*—The height curves and time charts for the 1924 tide-tables were completed on the machine by about the end of April 1923. The height curves for the 1925 tide-tables have already been run off on the machine, and it is hoped to complete the time charts for 1925 by about the end of October 1923.

46. No. 17 Party.—Levelling.—Five double detachments (one of which started as a single detachment) and one special levelling detachment were employed during the past season on the levelling operations summarised below :—

(*a*) *In the Punjab*, for the Sutlej Valley Irrigation project.—

PERSONNEL.

Class I Officers.

Major A. H. Gwyn, I.A., in charge from 19th March 1923.
Bt.-Major K. Mason, M.C., R.E., in charge to 18th March 1923.
Captain E. A. Glennie, D.S.O., R.E.

Class II Officers.

Mr. G. J. S. Rae
" O. N. Pushong
" Raj Bahadur Mathur, B.A.
" K. S. Gopalachari, B.A.

Upper Subordinate Service.

5 Officers.

Lower Subordinate Service.

25 Computers, &c.
41 purely temporary Levellers.

(*i*) From Kasūr to Ratta Tibba and Lodhrān,
From Ratta Tibba to Islām and Kaim Rais-ki-got,
From Kutabpur to Adamwāhan,
From Lodhrān to Bahāwalpur,
From Bahāwalpur to Fāzilka,
From Kandhyawāla to Hāsilpur.

(*ii*) From Khudiān to Lodhrān.
From Dingarh to Khānpur
From Mithra to Khānpur
From Chachran to Khān Belā
From Fāzilka to Ferozepore.

(*iii*) In the Multān and Montgomery districts, a close network of "tertiary" levelling, controlled by (*i*) and (*ii*).

(*b*) *In Bombay* for the Ghatprabha Irrigation project.—

(*i*) From Gotar to Kalādgi

(*ii*) From Mudhol to Jodhatti

(*iii*) From Hukeri Road railway station to Mudhol.

(*c*) *In Bombay*

(*i*) From Ahmadnagar to Dhond.

In Madras

(*ii*) From Gooty to Ongole.

These two lines were run in order to give heights to Survey of India bench-marks.

(*d*) *In Burma*, for the Public Works Department (Irrigation).—

(*i*) From Nyaungzaye to Yandoon and Maletto.

(*ii*) From Yandoon to Kandin.

(*iii*) From Ma-ubin to Bassein.

(*iv*) From Sagamya to Pantanaw.

(*e*) *In Bombay and the Punjab*, from Jacobābād to Khānpur and from Khānpur 15 miles southwards.

These lines form part of the new level net of India.

(*f*) *In Bombay*, for the Sukkur Barrage project.—

(*i*) From Shāhpur to Mīrpur Purāna.

(*ii*) From Landhi canal bungalow (39th mile Jāmrao) to Khipro *via* Jhol and Lun Khān.

(*iii*) From Khipro to Ghulām Bhurgari.

(*iv*) From Mīrpur Khās to Tando Ghulām Alī *via* Umarkot, Nabisar, Wango, Dadah and Mātli.

(*v*) From Mīrpur Khās to Tando Ghulām Alī *via* Mir Wāh Gorchūni, Digri and Dumbalo.

(*vi*) From Digri to Dadah.

The party completed 205 miles of primary, 2,793 miles of secondary and 13,889 miles of tertiary levelling; of which 2,479 miles of secondary and all the tertiary levelling were done for Local Governments.

MAGNETIC SURVEY.

47. No. 18 Party.—Magnetic.—The declination, horizontal force and vertical force magnetographs were in operation throughout the year at the Dehra Dūn and Toungoo observatories and daily absolute magnetic observations were taken regularly by the observers in charge. The observatories were visited during the field season and declination, dip, and horizontal force observations were taken for the comparison of instruments.

PERSONNEL.

Class I Officer.
Mr. E. C. J. Bond, V.D., in charge.

Class II Officers.
Mr. Nikunjo Ronjon Mazumdar.
,, Jiya Lal Sahgal.

Upper Subordinate Service.
2 Officers.

Lower Subordinate Service.
1 Magnetic Observer.
9 Computers, etc.

The Kodaikānal and Alibāg observatories, under the control of the Meteorological Department, were also visited for the same purpose.

Observations at Repeat Stations.—Magnetic observations were taken this field season at the six repeat stations, Quetta, Karāchi, Bīna, Dibrugarh, Barrackpore and Waltair; these observations are intended to supplement the 5-yearly observations at all repeat stations so that the annual changes in the magnetic elements may be accurately determined.

Publication of the results of the magnetic survey.—The results of the observations at the observatories, repeat and field stations, reduced to the epochs 1909·0 and 1920·0 are now under publication.

The magnetic elements at the observatories.—The computation and tabulation of the values of declination, dip, horizontal force and vertical force for the three observatories—Dehra Dūn, Toungoo and Kodaikānal—for the year 1922 have been completed; the mean values of these elements derived from all days, excluding those of great disturbance are given in the table below :—

MEAN VALUES OF THE MAGNETIC ELEMENTS AT OBSERVATORIES IN 1922.

Observatory.	Latitude & Longitude.	Dip.	Declination.	Horizontal Force.	Vertical Force.
	° ′ ″	° ′	° ′	C. G. S.	C. G. S.
Dehra Dūn ...	30 19 19 N 78 3 19 E	N 45 8·6	E 1 43·2	·32927	·33091
Toungoo ...	18 55 45 N 96 27 3 E	N 23 7·2	W 0 29·7	·39156	·16717
Kodaikānal ...	10 13 50 N 77 27 46 E	N 4 40·1	W 1 58·7	·37878	·03093

PART 3.—OFFICE WORK.

I.—HEAD QUARTER OFFICES.

MAP PUBLICATION OFFICE (*vide* Index maps at end).

SUPERINTENDENT (Lt.-Col. E. T. Rich, C.I.E., R.E., up to 21st Oct. 1922. Lt.-Col. E. A. Tandy, R.E., from 22nd Oct. 1922 to 7th. June 1923. Lt.-Col. A, A. McHarg, D.S.O., R.E., from 8th June 1923.

48. Brief reports of the work carried out during the year under review in the six offices administered by the Map Publication Office are given in paras. 50 to 54, 62, 63, 74 and 75.

PERSONNEL.
Class II Officer.
Mr. Pramadaranjan Ray, B.S.

49. The classes of maps for the publication of which the Head Quarter Offices are responsible are as follows:—

(*a*) Topographical maps on the one-inch scale.
(*b*) Topographical maps on the half-inch scale.
(*c*) Topographical maps on the quarter-inch scale.
(*d*) (*i*) Geographical maps on the 1:1,000,000 scale (about 1 inch = 16 miles).
(*ii*) La Carte Internationale du Monde on the 1:1,000,000 (about 1 inch = 16 miles).
(*e*) Geographical maps on the 1:2,000,000 scale (about 1 inch = 32 miles).
(*f*) General maps on the same and smaller scales.
(*g*) Special maps.

The progress made in the publication of each of these classes is detailed below:—

(*a*) Topographical maps on the one-inch scale.— During the year 88 modern sheets have been published.

Index map No. 2 at the end of this report shows the progress made in the publication of the modern one-inch public sheets, and the following table gives the output of these sheets since the modern topographical surveys were begun:—

Years of publication.	Number of one-inch sheets published.			
	Northern Circle.	Southern Circle.	Eastern Circle. *	Total.
1906-14	421	266	349	1,036
1914-15	97	48	9	154
1915-16	85	69	50	204
1916-17	23	40	22	85
1917-18	18	12	13	43
1918-19	32	19	6	57
1919-20	15	37	52	104
1920-21	15	11	19	45
1921-22	20	46	29	95
1922-23	**32**	**38**	**18**	**88**
Total published ...	758	586	567	1,911
Probable number of one-inch sheets which will not be published owing to the area covered by them being included in the programme for survey and publication on the half-inch scale ...	911	564	473	1,948
Approximate number remaining for publication ...	483	879	997	2,359
Approximate number of public one-inch sheets in India	2,152	2,029	2,037	6,218

* Includes Burma Circle.

In addition to the above, preliminary editions (in colours) of 15 one-inch sheets, prepared from modern revenue surveys, have been published during the year pending their topographical revision.

173 modern one-inch, 13 preliminary editions, 2 provisional issues of one-inch, and 122 old style one-inch sheets have been reprinted during the year.

(*b*) **Topographical maps on the half-inch scale.**—Index map No. 3 at the end of this report shows the progress made in the publication of the modern half-inch public sheets. This series now forms the *tactical* map of India, having taken the place of the quarter-inch maps in this respect. It was commenced in 1914; most of the sheets published up to date are reductions from the one-inch map but others are from direct half-inch surveys.

The following table gives the output of these sheets:—

Years of publication.	Number of half-inch sheets published.		
	Drawn from component one-inch sheets.	Surveyed on half-inch scale.	Total.
1914-15	...	1	1
1915-16	21	4	25
1916-17	50	6	56
1917-18	59	6	65
1918-19	26	4	30
1919-20	31	8	39
1920-21	59	2	61
1921-22	75	7	82
1922-23	**52**	**4**	**56**
Totals	373	42	415
Approximate total number of half-inch sheets in India	.....	.....	1,630

26 modern and 1 preliminary public half-inch sheets have been reprinted during the year.

(*c*) **Topographical maps on the quarter-inch scale.**—These maps are prepared in "degree" sheets which include 1° of latitude and 1° of longitude, *i.e.*, the area covered by 16 one-inch sheets, or 4 half-inch sheets.

Index map No. 4 at the end of this report shows the progress made in the publication of the modern quarter-inch public sheets.

The following table gives the output of these sheets:—

Years of publication.	Number of "Degree" sheets published.			
	Northern Circle.	Southern Circle.	Eastern Circle.*	Total.
1911-14	9	5	7	21
1914-15	1	3	3	7
1915-16	...	1	4	5
1916-17	1	...	3	4
1917-18	...	...	4	4
1918-19	...	3	8	11
1919-20	4	...	4	8
1920-21	1	...	...	1
1921-22	1	3	6	10
1922-23	**10**	**8**	**2**	**20**
Totals	27	23	41	91
Approximate number of "degree" sheets in India	170	140	140	450

*Includes Burma Circle.

7 preliminary sheets in colours from comparatively modern surveys have been published and 17 modern and 8 preliminary sheets are at press.

In addition to the above, 46 modern and 9 preliminary public quarter-inch sheets have been reprinted during the year.

24 quarter-inch sheets have been prepared in No. 1 Drawing Office from the old engraved quarter-inch Atlas sheets brought up to date and published (in black only) as provisional issues; and 27 of such sheets which were published previously have been reprinted during the year. These "provisional" quarter-inch sheets, including those in hand, now cover the greater part of the area of India for which modern "degree" sheets are not likely to be available for some time.

(*d*) **Geographical Maps on the 1:1,000,000 scale.**—(*i*) **The "India and Adjacent Countries" Series** (*Vide* Index map No. 5).—During the year 1 new sheet of this series has been published, 6 sheets have been engraved and 20 sheets have been reprinted.

(*ii*) **La Carte Internationale du Monde.**—(*Vide* Index map No. 6).—A full description of the genesis of this series was given in the General Report for 1913-14. 12 sheets have been published up to date.

(*e*) **Geographical Maps on the 1:2,000,000 scale.**—(*Vide* Index map No. 7).—1 map of this series was reprinted during the year.

(*f*) **General Maps on the same and smaller scales.**—The engraved plates of all these maps have been corrected and brought up to date as far as possible and 8 maps have been reprinted during the year.

(*g*) **Special maps.**—The annual edition of the Railway Administration map (on the scale of 1 inch = 64 miles) has been reprinted with corrections during the year; 5 provincial maps and the map of India showing railways, canals and roads without corrections (on the scale of 1 inch = 32 miles) have been reprinted.

Numerous special maps have also been prepared and printed for the Army, for Local Governments, Railways and for other Departments.

Two new sheets Nos. 18 & 19 of the Calcutta and Howrah Town Guide Map, scale 12 inches = 1 mile, have been published during the year and one sheet (No. 12) has been reprinted.

Plan of City of Calcutta on scale 3 inches = 1 mile has also been reprinted during the year.

50. Map Record and Issue Office.—During the year the issues of maps to Government officials and sales to the public continued to increase.

PERSONNEL.

Class I Officer.

Major F. F. Hunter, D.S.O., I.A., in charge.

A diagram showing the values of maps issued during the past 10 years will be found on the opposite page.

1,178,461 maps, plans, diagrams, etc., valued at Rs. 4,63,453, were issued during the year, which may be compared with 359,917, valued at Rs. 2,11,014, issued in 1913-14.

A satisfactory feature is the increased demand for maps from the general public to whom the numbers issued by this office in 1922-23 were 219,746 valued at Rs. 83,724 as compared with 104,750, valued at Rs. 62,075 issued last year.

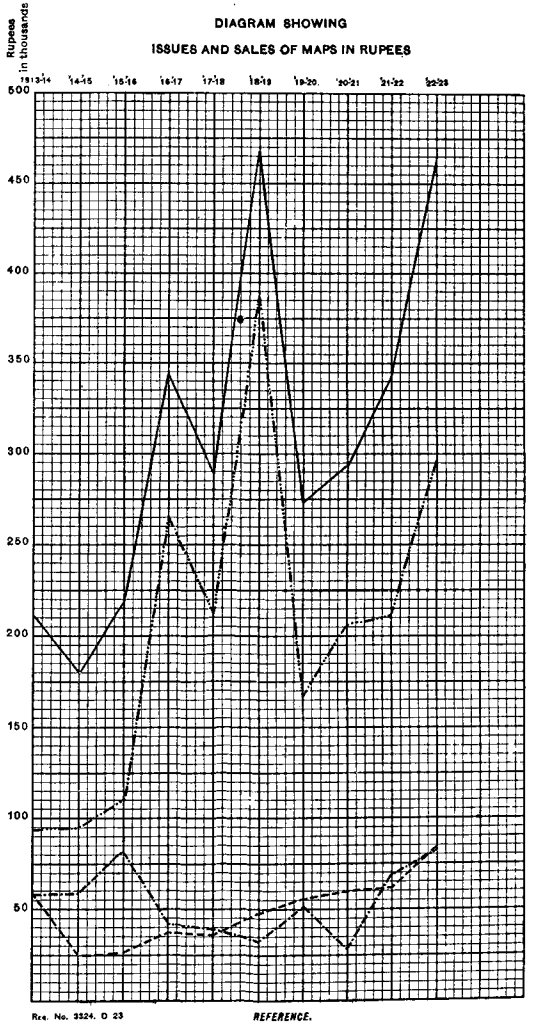
This increase is due to modest advertisements in the press as far as was possible within a limited budget provision.

A new and simplified Catalogue was published; this included extract specimens of most classes of maps published by the department.

The reorganization of the map record room continued, and arrangements have been completed for storing every modern sheet in some kind of enclosed rack. 67 steel racks, fireproof and enclosed, containing 808 shelves have been erected to date.

DIAGRAM SHOWING

ISSUES AND SALES OF MAPS IN RUPEES



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REFERENCE.

Cash sales

Free issues to Govt. Officials

Book-debit sales to Govt. Officials

Grand total.

Many maps previously mislaid in the past, on account of unsatisfactory storage, have been recovered and properly listed.

The branch office at 5, Esplanade East, Calcutta, continues a success.

Issues.—From the Map Record and Issue Office.

Year.		On Book Transfer (to Government Officials).		On Cash Payment (to Private Individuals and Map Agents).		Free Issues.		Total.	
		Number of Printed Copies.	Value Rs.	Number of Printed Copies.	Value Rs.	Number of Printed Copies.	Value Rs.	Number of Printed Copies.	Value Rs.
1922-23	Departmental Maps.	224,895	2,04,398	51,991	59,765	46,547	79,128	323,433	3,43,291
	Extra-departmental Publications.	669,747	92,561	167,755	23,959	17,526	3,642	855,028	1,20,162
	Total ...	894,642	2,96,959	219,746	83,724	64,073	82,770	1,178,461	4,63,453
1921-22	Total ...	1,222,832	2,10,510	104,750	62,075	67,812	68,903	1,395,394	3,41,488
1920-21	Total ...	1,593,868	2,06,402	136,728	59,568	56,824	28,175	1,787,420	2,94,145

Total number of requisitions and enquiries for maps received in the Map Record and Issue Office.

Year 1920-21	7,974
,, 1921-22	8,868
,, 1922-23	8,860

Table III.—Publications received in Map Record & Issue Office, during the year 1922-23.

A.—From the Calcutta Printing Offices, (including the Engraving Office).

Class of Maps.	Scale.	Number of different maps of each class received.		Number of sheets printed.	Value.
		New Publications.	Reprints and New Editions.		
DEPARTMENTAL.					
GENERAL MAPS.					*Rs.*
Maps of India	Various	...	9	7,254	8,080
GEOGRAPHICAL MAPS.					
Southern Asia Series ...	1:2,000,000	...	1	225	307
India and Adjacent Countries Series.	1:1,000,000	1	20	10,880	16,320
TOPOGRAPHICAL MAPS.					
Quarter-inch, (Modern) ...	1″=4 miles	32	46	30,729	45,316
Do. (Prely.)... ...	1″=4 miles	7	9	4,150	6,225
Do. (Provl.)... ...	1″=4 miles	24	27	11,200	13,375
Half-inch, (Modern)	1″=2 miles	74	26	38,908	1,15,974
Do. (Prely.)	1″=2 miles	...	1	867	2,601
One-inch, (Modern)	1″=1 mile	81	173	176,816	2,61,156
Do. (Prely.)	1″=1 mile	15	13	7,992	11,975
Do. (Provl.)	1″=1 mile	1	2	2,433	3,550
Old Style sheets	Various	...	122	16,720	27,159
SPECIAL MAPS.					
District Maps	1″=4 miles	...	1	100	150
Administration Report Maps ...	1″=8 miles	...	10	1,050	390
Provincial Maps	Various	...	5	2,125	4,947
Plans of Cities and Cantonments...	Various	2	2	1,700	743
Index Maps	Various	...	119	190,734	17,152
Miscellaneous Maps	Various	18	9	18,700	9,551
Total ...	.....	**255**	**595**	**522,583**	**5,44,971**
EXTRA-DEPARTMENTAL.					
Maps	Various	95	81	144,864	42,739
Plans and Diagrams	Various	689	19	173,364	23,676
Illustrations	.....	220	3	81,067	16,644
Miscellaneous	.....	230	78	369,706	18,812
Total ...	.....	**1,234**	**181**	**769,001**	**1,01,871**
Grand Total ...	.....	**1,489**	**776**	**1,291,584**	**6,46,842**

B.—From the Trigonometrical Survey Office, Dehra Dūn.

Various	Various	6	13	4,221	5,852

C.—LETTERPRESS.

1. Survey of India General Report, 1921-22. *Price Rs. 2 or 4s.*
2. Catalogue of Maps published by the Survey of India, 1923. *Price Re. 1 or 2s.*
3. Routes in the Western Himālaya, &c., Volume I, Pūnch, Kashmīr and Ladākh, &c., by Major K. Mason, M C., R.E. 1922. *Price Rs. 6 or 12s.*

PERSONNEL.

Class I Officers.

Lieut.-Colonel A. A. McHarg, D.S.O., R.E., in charge from 1st May to 7th June 1923.

Mr. J. Prasad, R.B., in charge to 30th April 1923 and from 8th June 1923.

Class II Officers.

Mr. P. Williams.
„ Abinash Chunder Bose.
„ C. West.
„ A. B. Hunter.
„ Priya Nath Sur.
„ F. B. Kitchen.
„ Munshi Lal, B.A.
„ H. T. Hughes.
„ P. C. Mitra, B.A.

51. No. 1 (Head Quarters) Drawing Office.—The organization of the office remained substantially the same as last year.

The work carried out by the various sections was as follows:—

(1) *The Compilation Section.*—

(*a*) "La Carte Internationale du Monde au 1,000,000".—Nine sheets were reported in hand last year; no new sheet was taken up this year. Of the nine sheets, one sheet has been completed and sent in for publication. Three have been completed and are about to be sent to press, contour pattern of one sheet and outline patterns of two sheets have been completed and sent to the Engraving Office. Contour patterns of the remaining two are in hand.

(*b*) The Southern Asia Series, scale 1:2,000,000.—Of the seven sheets reported in hand last year, two have been completed and sent in for publication, complete outline and contour patterns of three have been sent to the Engraving Office. Of the remaining sheets, outline pattern of one is under examination and a part of outline pattern of the other is in hand. No new sheets were taken in hand during the year under report.

The original of the helio. edition of one sheet has been brought up to date and sent to press for reprint.

(*c*) India and Adjacent Countries, scale 1:4,000,000.—Final proofs have been passed and sent to the Engraving Office.

(*d*) Miscellaneous.—

(*i*) Preparation of the new 50-mile Wall Map of India was taken in hand during the year under report.

(*ii*) Minor corrections to 2,021 stock copies of modern maps were carried out for the Map Record and Issue Office.

(*iii*) Various indexes for the Catalogue have been brought up-to-date.

(*iv*) Indexes for the General Report have been completed.

(2) *The "One-Millionth" Section.*—

(*a*) Engraved editions.—Eight sheets were reported in hand at the close of last year and three new sheets were taken up during the year. Of these eleven, two were completed and sent in for publication, one is ready for press, outline patterns of three have been completed and sent to the Engraving Office, and outline patterns of the remaining five are in hand.

Patterns for three sheets were prepared and sent to the Engraving Office for correction of plates for reprint.

(*b*) Helio. editions.—Outline original of one sheet in hand has been completed and contour original is in hand.

(*c*) Reprints.—Originals of six sheets have been brought up to date and sent to press for reprint. One is in hand.

(*d*) Miscellaneous.—The border specimen for 1/M sheets (helio. edition) has been revised and published, patterns of twenty-six standard indexes have been prepared and sent to the Engraving Office for correction of plates and traces of nine and originals of three other miscellaneous maps have been prepared.

(3) *The Quarter-Inch Section.*—

(*a*) Original compilation and drawing.—At the end of the last year there were eleven ¼-inch sheets in hand; no new sheet was taken up during the year under report. Of these eleven, seven have been completed and sent in for publication, three sheets are in hand; work on one was stopped under the orders of the Surveyor General.

(*b*) Miscellaneous.—

(*i*) Stump-shaded originals of ninety-one sheets were prepared and sent in for publication. Those of three quarter-inch sheets and of the 50-mile Wall Map of India are in hand.

(*ii*) Press order proof corrections have been inserted on the original fair sheets of seventeen modern topographical maps.

(*iii*) Various corrections have been carried out on the originals of thirty-seven sheets.

(*iv*) The drawing of the "Vivid Map of India" for the British Empire Exhibition on the sixteen-mile scale is in hand.

(4) *The Reprint Section.*—

(*a*) Seventy-eight old style one-inch sheets (including seventeen sheets in hand at the close of last year) were brought up-to-date and sent to press for reprint, seven sheets remain in hand.

(*b*) Ten one-inch sheets were corrected to modern graticules, brought up-to-date and sent to press for reprint; modernisation of nine sheets is still in hand.

(*c*) Forty-four one-inch and half-inch sheets were corrected to modern graticules and sent to press for supply of blue prints to parties for revision survey.

(*d*) Eighteen provisional quarter-inch sheets (including eleven in hand at the close of last year) were compiled from Indian Atlas sheets and sent to press for publication. This completes the programme of compilation of quarter-inch sheets from Atlas material.

(*e*) Thirty provisional quarter-inch sheets compiled from Indian Atlas material (including eleven in hand at the close of last year) were brought up-to-date from office copies and sent to press for reprint.

(*f*) One Indian Atlas sheet and twenty-three miscellaneous maps have been brought up-to-date from office copies and sent to press. Six sheets are still in hand.

(5) *The Mapping Section.*—

(*a*) One hundred and fifteen modern topographical sheets (including seven in hand at the close of last year) were corrected and brought up-to-date from office copies and sent for reprint. Two sheets remain in hand.

(*b*) Press order proof corrections have been carried out on the original fair sheets of one hundred and thirty-seven modern topographical sheets (including ten in hand at the close of last year); two sheets remain in hand.

(*c*) The original of the 64-mile Railway Map of India was brought up-to-date and sent for reprint.

(*d*) Black prints of plane-table sections of twenty-six sheets were pasted together for supply of blue prints to various parties.

(*e*) Forty-seven fair, and print original, sheets and colour patterns of various special maps (including seven in hand at the close of last year) have been completed and sent to press. These include maps prepared for census, railway, commercial, military and other departments. Four miscellaneous cases are still in hand.

(6) *The Office Copy Section.*—

(*a*) Additions and corrections received from various local authorities, have been entered on the existing "office copies" of 2,214 sheets. 718 "office copies" of newly published or reprinted sheets have also been prepared during the year.

(*b*) The areas of 196 newly published one-inch and half-inch sheets were checked against the Auxiliary Tables and entered in the Area Register.

(*c*) The miscellaneous work of this section includes—

(*i*) supply of authenticated copies of revenue and historical maps, revenue data from field books and other records to officials and private persons,

(*ii*) the preparation of complete sets of maps of the Districts and States of India with a view to bring their "office copies" up-to-date by references to the various Local Governments.

(7) *The Examining Section.*—

This section is responsible for the examination of the sheets drawn by other sections in the office.

210 cases pertaining to 309 sheets have been examined during the year; six cases pertaining to six sheets remain in hand.

In addition to the above current work this section supplied scientific data to various officials, kept up corrections to Imperial Gazetteers,

examined projections of sheets on copper plates in the Engraving Office, checked geographical names in various Survey of India publications, drafted correction slips to the topographical hand-book and tables, conventional signs, &c. The alphabetical index to names for the new 50-mile Wall Map of India is in hand.

PERSONNEL.

Class I Officers.

Lieut.-Colonel A. A. McHarg, D.S.O., R.E., in charge from 1st May to 7th June 1923.

Mr. J. Prasad, B.B., in charge to 30th April 1925 and from 8th June 1923.

52. Engraving Office.—(1) *Engraving Section.*—This section has been employed on the following during the year—

(*a*) *India & Adjacent Countries.*—Scale 1 : 1,000,000.

Out of the five sheets in hand last year, two are in their final stage and will very shortly be sent in for publication, two are nearing completion, and one is well advanced. One new sheet was projected and has progressed as far as completion of outline, and another new sheet was projected and is awaiting material.

(*b*) *La Carte Internationale du Monde.*—Scale 1 : 1,000,000.

Out of the seven sheets in hand, two are in their final stage, and will be sent in for publication very shortly; two are very nearly completed; and two are well advanced; the remaining one is in a preliminary stage. No new plates were projected.

(*c*) *Southern Asia Series.*—Scale 1 : 2,000,000.

Out of six sheets in hand last year, one (North Tibet) will very shortly be ready for publication. The work on one (Koko Nor) was stopped awaiting fresh material from No. 2 Drawing Office. One (Brahmaputra) was nearing completion, but portions have to be re-engraved to incorporate new work received from No. 2 Drawing Office. One (Calcutta) has been partly completed and awaiting material; two (Bombay and Delhi) are well advanced. One new sheet (Kashmir) was projected and outline completed.

(*d*) The miscellaneous work has been very heavy. Corrections and additions to 1/4M India have been completed, and final proofs are in hand. Office copy corrections are being carried out on all the maps of India on different

scales, as also on the complete set of the 32-mile Indices. Two Commission forms for officers in the Indian Hospital Corps in English and Urdu and in English and Hindi have been engraved and an inset of the British Isles for the 32-mile map of India was drawn for reproduction. Six titles on photogravure plates for the Geological Survey of India were engraved as well as a new title plate for 1/M sheets. Two new pages have been added to the Copy Book of Lettering. Ten district maps and the table of Conventional Signs have been corrected and brought up-to-date. Compilation of various insets and colour scheme for the 50-mile Wall Map of India is progressing.

(2) *Copper Plate Printing Section.*—29,191 impressions were pulled during the year, against 29,876 during the preceding year. 44 % of this work was extra-departmental, consisting of photogravures, charts, commission forms and certificates. Of the departmental work about 33 % consists of scales, and the rest transfers, art paper prints and prints from various plates, such as Atlas sheets, district maps, etc.

In the Electro-typing section 96 plates were dealt with.

53. Photo.-Litho. Office.—The main feature of the year under report is the increased out-turn of the office—the figure which best represents the out-turn being the number of impressions pulled in the Litho. Branch. This figure this year reaches 4,035,405 (*vide* column 2 of Table B). This figure has only been surpassed on two occasions, *viz.*, in 1917-18 (4,796,813) and in 1918-19 (4,248,913). The increased out-turn this year is due to the fact that a large number of maps were reprinted for mobilisation purposes for the Chief of the General Staff.

PERSONNEL.
Class I Officer.
Major F. J. M. King, R.E., in charge.

As a result of economies during the past year the cost of the office (column 2 of Table A) has been reduced by over Rs. 40,000 as compared with 1921-22, while the "profits," arrived at by deducting the total cost of the office, including European stores, from the value of the out-turn, amount to Rs. 1,59,640 against Rs. 90,596 in 1921-22.

During the year the *Type Section* has cleared off practically all its arrears and this has been accomplished partly by the curtailing of a number of forms formerly printed in the section and partly by the installation of a ruling machine which has been running during most of the year.

The following tables briefly summarise the work of the office during the last 3 years :—

TABLE A.—WHOLE PHOTO.-LITHO. OFFICE.

1	2	3	4	5	6
Year.	*Cost of office.	Value of out-turn at office rates.	NUMBER OF MAPS PRINTED.		
			Departmental.	Other than Departmental.	Total.
	Rs.	*Rs.*			
1920-21	2,70,193	4,77,839	625	2,546	3,171
1921-22	3,05,038	5,37,535	666	2,993	3,659
1922-23	**2,64,415**	**5,71,286**	**956**	**2,760**	**3,716**

* Does not include cost of chemicals, paper, &c., obtained from England.

TABLE B.—LITHO. BRANCH.

1	2	3	4	5	6	7
Year.	Number of impressions pulled in Litho. Branch.	Number of half-tone impressions pulled.	Number of line-block impressions pulled.	TYPE SECTION OUT-TURN.		
				Pages or items published.	Copies printed.	Impressions pulled.
1920-21	3,736,999	237,976	501,265	3,429	2,034,962	3,609,532
1921-22	3,543,470	90,633	745,670	2,854	933,391	1,766,319
1922-23	**4,035,405**	**51,069**	**328,628**	**2,815**	**1,026,900**	**1,593,605**

TABLE C.—PHOTO. BRANCH.

	1920-21.	1921-22.	1922-23.
Negatives	5,786	5,894	**5,604**
Zinc plates	7,591	7,395	**7,078**
Photogravure plates ...	490	475	**605**
Half-tone blocks ...			
Line blocks			

54. Mathematical Instrument Office.—During the year from 1st April 1922 to 31st March 1923, there was an increase in the demands made on this office for instruments, &c., (*vide* item 1 in para. 2 below) and the Store Section of the Office made a profit of Rs. 63,358 against a profit of Rs. 47,044 in 1921-22. There was also an increase in the value of work done (*vide* item 6 in para. 2 below) and the Workshop Section of the Office made a profit of Rs. 39,718 against a loss of Rs. 38,910 in 1921-22.

PERSONNEL.

Mr. T. A. Forrier, C.B.E., in charge to 14th February 1923.

Mr. S. Woodhouse, in charge from 16th February 1923.

2. The following table shows the usual comparative figures for the last three years :—

		1920-21.	1921-22.	1922-23.
		Rs.	*Rs.*	**Rs.**
1.	Total issues of stores to Public Offices as shown in the Profit and Loss statements.	4,74,911	5,32,768	**6,25,953**
2.	Value of repairs to instruments received for repairs and returned in serviceable condition.	96,089	1,18,445	**1,70,010**
3.	Value of instruments received from Government Officers when no longer required.	70,484	58,743	**83,933**
4.	Book value of the stock of instruments, &c., in Serviceable Stores.	5,06,988	6,91,499	**5,75,844**
5.	Book value of the stock of instruments, &c., in Repairable Stores.	1,07,873	1,25,646	**1,26,616**
6.	Total value of work done in the Workshop.	4,81,809	4,20,408	**4,89,329**
7.	Value of instruments manufactured in the Workshop for Serviceable Stores.	1,82,644	1,76,123	**1,68,588**
8.	Value of instruments purchased locally	41,063	11,296	**22,840**
9.	Value of instruments and materials obtained from England through the Director General of Stores.	2,98,795	4,58,016	**2,20,650**
10.	Average No. of employees and their pay	No. 618 Rs. 1,77,655	No. 628 Rs. 1,93,658	**No. 554 Rs. 1,88,009**

3. During the year the stock of all the three stores (the Serviceable, the Repairable and the Material Stores), was twice taken as usual and the discrepancies found were duly adjusted.

II.—DEHRA DŪN OFFICES.

TRIGONOMETRICAL SURVEY OFFICE.

55. Computing Office.—Computations on a large scale had to be carried out this year in compliance with extra-departmental requests. Special mention may be made of a requisition for the rectangular co-ordinates of over 5,000 points, and of another from the Director of Wireless Telegraphy requiring the preparation of data for the construction of a map of the world for the use of the Air Service. Hayford corrections were computed for a number of pendulum stations. The Talcott observations for latitude made last year by Bt.-Major K. Mason, M.C., R.E., at Gogipatri, Poshkar, Zebanwan and Reban in Kashmīr, were completely reduced.

PERSONNEL.

Class I Officers.

Dr. J. deGraaff Hunter, Sc.D., M.A., F. Inst. P., in charge from 27th November 1922.

Major C. M. Thompson, I.A., in charge to 26th November 1922.

Class II Officer.

Mr. Hanuman Prasad, B.S.

Upper Subordinate Service.

1 Officer.

The form of the geoid (sea level surface) in India has been deduced from all the deflection results obtained by the Survey of India, and exhibited by means of contours on a $\frac{1}{5M}$ map. This shows the elevation of the geoid from the spheroid of reference. The desirability of such representations of the geoid for all geodetically surveyed portions of the globe has been pointed out by the International Geodetic Association.

The preparation of a revised and extended 5th edition of the Auxiliary Tables of the Survey of India is in progress. Part III, of which a small edition was printed last year, has been further supplemented by 13 new tables, and a full edition of this part is in course of printing. The professional forms of the department are being revised. 24 forms have been remodelled up to date.

The list of the protected stations of the Trigonometrical Survey numbering 4,000, was scrutinized and amended with a view to effecting economy in the maintenance of these stations.

250 requisitions for data from departmental and non-departmental officials were complied with.

Triangulation pamphlets were compiled for 61 degree sheets. These include 48 of Mesopotamian triangulation.

Type Printing Section.—The following were printed during the year:—

1. Records of the Survey of India, Volume XVI, 1920-21.

2. Records of the Survey of India, Volume XVII—Memoir on the Maps of Chinese Turkistān and Kansu, (Sir A. Stein, K.C.I.E.).
3. Tide-tables for Indian Ports, 1924.
4. 28 Triangulation pamphlets.
5. Levelling pamphlets 63 and 78.
6. Auto-stereo plotter, a translation from the French of Paul Corbin (Lt.-Col. H. McC. Cowie, R.E.).
7. Levelling of Precision in Mesopotamia.
8. Catalogue of books in the Library of the Trigonometrical Survey Office.

The following are in hand :—

(*i*) Records of the Survey of India, Volume XVIII, 1921-22.
(*ii*) Records of the Survey of India dealing with the Magnetic Survey of the country.
(*iii*) Levelling pamphlet 79.
(*iv*) Hand-book of Topography, Chapters II and III (both revised).
(*v*) Type book of the Trigonometrical Survey Office.

Observatories.—Meteorological observations were continued as usual, and the Omori Seismograph was in operation throughout the year. The time at which meteorological observations are taken has been changed from 14 hours to 10 hours.

Photographs of the sun were taken on 306 days, the sun being obscured during the remaining days of the year.

Preservation of Trigonometrical Stations.—658 stations were repaired by district officers at a cost of Rs. 3,558. Out of 361 districts from which reports were due, 23 failed to make returns.

56. No. 2 (Dehra) Drawing Office.—During the year the work of the office was carried on by six sections. Owing to retrenchment at the beginning of the year, the Cantonment mapping section was abolished and the work handed over to the half-inch section. Towards the end of the year, a new section was formed to draw the levelling charts of the Sutlej Valley Irrigation project of the Punjab Government. This work is being done on payment.

PERSONNEL.

Class I Officer.

Lieut.-Colonel L. C. Thuillier, I.A., in charge.

Class II Officers.

Mr. H. B. Simons.
" Rama Prasad Ray, B.A.
" J. McCraken, M.B.E.

Upper Subordinate Service.

3 Officers.

(1) *The Triangulation Chart and Cantonment Section.*—Deals with the fair-drawing of triangulation, levelling and index charts, and the publication, reprint and correction of cantonment plans. In addition to the ordinary work of the section, 48 miscellaneous maps, charts and diagrams were dealt with and 351 sheets of cantonment plans hand-coloured.

(2) *The Compilation Section.*—Deals with the compilation and fair-mapping of geographical maps on different scales. Two fair sheets on the 1/M scale shown as in hand last year, were completed and sent to press. Four sheets of rough compilation on the 1/M scale were in hand at the end of last year, and one more sheet was taken up during the year; of these, one has been completed and is being fair-mapped and four are in hand. Of the rough compilation of sheets on the 1/2M scale 2 were in hand at the end of last year and one was taken up during the year; of these, two have been completed and sent to Calcutta, to be engraved and one remains in hand. The stump-shading of two sheets was in hand at the end of last year, and three more were taken up during the year; all these have been completed during the year. Three half-inch sheets shown as in hand in this section last year, have been completed and sent to press during the year. Two sheets of Sir H. H. Hayden's Tibet map and one sheet of Mount Everest map were taken in hand during the year; of these, two sheets have been fair-mapped and one of the former is still in hand. Materials for the rough compilation of five sheets of the map of Tibet on the scale of 1 inch = 8 miles are being collected.

(3) *The Stein's Section.*—Deals with the fair-mapping of Sir Aurel Stein's explorations in Chinese Turkistān and Kansu in 1900-01, 1906-08 and 1913-15. The remaining two sheets out of the 48 sheets of this series, have been published during the year. The fair-mapping of one special map sheet shown as in hand last year is still in progress, nearing completion. Eleven special triangulation charts and one levelling chart of this area shown as in hand last year, have all been fair-drawn and published during the year.

(4) *The Half-inch Section.*—Deals with the fair-mapping of half-inch sheets. All the thirteen sheets shown as in hand last year have been completed and sent to press during the year. This section has also completed the fair-mapping of five cantonment plans, and eleven further plans are in hand. Two of the plans have been combined into one and this makes up the total of 17 shown as in hand last year. This section

also took up the stump-shading of 4 sheets, of which 3 have been completed and one is in hand.

(5) *The Examining Section.*—Examines the majority of the important sheets drawn in this office. 129 sheets have been examined during the year (including the 34 sheets shown as in hand last year) and 22 sheets are in hand.

(6) *The Sutlej Valley Project Section.*—Was formed towards the end of the year under report to deal with the fair-drawing of the levelling charts (showing spot heights and contours) for the Sutlej Valley Irrigation project of the Punjab Government. Materials for 136 sheets have been received; and of these, 6 sheets have been fair-drawn and sent to press leaving a balance of 130 sheets in hand.

(7) *The Map Record Section.*—Deals with the storage of originals and office copies of cantonment plans, triangulation and other charts and geographical maps; it keeps a small stock of the various maps published by the department for occasional issue to the public and for departmental use and deals with all correspondence on this subject.

The following is the summary of the work of the office during the year 1922-23.

Class of maps.	Balance of sheets on 1st October 1922.	Sheets received in 1922-23.	Sheets sent to press in 1922-23.	Balance of sheets in hand on 1st October 1923.	Remarks.
Triangulation charts ...	17	28	26	12(a)	(a) Drawing of two charts stopped.
Levelling charts, scale 1/M	1	3	2	2	
Index charts to illustrate reports.	1	7	6	1(b)	(b) Publication of one index stopped.
Cantonment plans for publication.	34	67	26	75	
Cantonment plans for correction.	11	222	213(c)	20	(c) Corrections carried out in both originals and office copies.
Cantonment plans fair-drawing.	17	1	5	12(d)	(d) Two plans have been combined into one.
Forest maps of Indian States for publication.	...	15	...	15	
Miscellaneous maps, charts and diagrams.	21	40	57	4	
Colour guides of cantonment and other maps.	155	398	351	202	
Half-inch sheets ...	16	...	16	...	

Summary of the work of the office during the year 1922-23. *(concld.)*.

Class of maps.	Balance of sheets on 1st October 1922.	Sheets received in 1922-23.	Sheets sent to press in 1922-23.	Balance of sheets in hand on 1st October 1923.	REMARKS.
GEOGRAPHICAL MAPS.					
Fair sheets, scale 1/M ...	2	1	2	1	
Rough compilation, scale 1/M.	4	1	1(*e*)	4	(*e*) Being fair-mapped.
Rough compilation, scale 1/2M.	2	1	2(*f*)	1	(*f*) Sent to Calcutta for engraved edition.
Stump-shading, various scales.	2	7	8	1	
Sir H. H. Hayden Tibet maps.	...	2	1	1	
Mount Everest map ...	...	1	1	...	
Sutlej Valley project level and contour charts, scale 1 inch = 4 miles.	...	136	6	130	
Sir Aurel Stein's explorations in Chinese Turkistān and Kansu in 1900-01, 1906—08 and 1913—15, for publication on 2/M scale.	1	...	...	1	

Photo.-Zinco. Section.—During the year 1922-23 the work undertaken comprised:—

Cantonment plans.

Indexes and Triangulation charts.

Forest maps.

Maps illustrative of Sir Aurel Stein's explorations.

Map illustrative of Sir H. H. Hayden's explorations.

Miscellaneous maps.

Extra-departmental maps.

The following table shows the work done in the last three years:—

Years.	No. of Subjects.	No. of Negatives.	No. of Pulls.	No. of Chocolate and Bromide prints.
1920-21 ...	1,430	1,911	436,996	447
1921-22 ...	1,480	2,028	305,415	...
1922-23 ...	**1,719**	**1,580**	**318,229**	**1,198**

57. Forest Map Office.—The strength of the office was reduced during the year by half, but its organization remained substantially the same as last year.

PERSONNEL.

Class I Officer.

Lieut.-Colonel L. C. Thuillier, I.A., in charge.

Class II Officers.

Mr. H. P. D. Morton.
,, Asmat-ullah Khan, K.B.
,, T. F. Kitchen.
,, Nanak Chand Puri, B.A., R.S.

Upper Subordinate Service.

2 Officers.

The work carried out by the various sections was as follows :—

(1) *The Drawing Section.*—The progress of this section is shown in the table below :—

Class of map.	In hand on 1st October 1922.	Received during the year.	Drawn and sent for publication during the year.	In hand on 30th September 1923.	Published during the year.	Total number of copies printed.
(*a*) ...	2	51	33	20	67	21,688
(*b*) ...	54	45	58	41	80	
(*c*) ...	11	4	13	2	17	
(*d*) ...	...	41	38	3	33	
(*e*) ...	...	4	2	2	1	
(*f*) ...	32	7	14	25	17	
(*g*) ...	...	8	6	2	3	
Total 1922-23.	**99**	**160**	*164	**95**	**218**	
Total 1921-22.	...	176	*214	...	199	23,551

* Includes two-inch and four-inch forest maps drawn by survey parties.

(*a*) Reprints of forest maps on various scales.
(*b*) Forest editions on the two-inch scale of modern one-inch maps.
(*c*) Maps of Forest Circles and Divisions.
(*d*) Maps to illustrate working plans, etc.
(*e*) Maps and diagrams to accompany Administration Reports.
(*f*) Forest maps from special surveys, mostly on the four-inch scale.
(*g*) Index and miscellaneous maps.

(2) *The Portfolio Section.*—Office copies of 455 maps and colour specimens of 62 maps were prepared; corrections to 204 sheets were completed, 69 office copies were coloured up and 1,704 sheets were hand coloured for issue on indent. In addition this section corrected the forest information on 328 maps for the various Survey of India drawing offices requiring them for compiling the half-inch and degree sheets.

(3) *The Map Record Section.*—The number of maps, diagrams and original fair sheets received for storage was 12,881; 3,675 maps, etc., valued at Rs. 9,347 were issued gratis. Sales by book-transfer to Government departments amounted to Rs. 3,137 for 1,027 maps; these figures show a decrease of 1,787 maps and Rs. 2,568 from those for last year. Cash sales to the public amounted to Rs. 2,035 for 902 maps, a decrease of Rs. 304 from the amount realized the previous year.

(4) *Book-Binding Section.*—This section dealt with 267 volumes for the Forest Research Institute, the value realized by book-transfer and cash being Rs. 681.

As the working arrangements of this section were not proving entirely satisfactory, and in anticipation of having to retrench its personnel, it was closed down in the month of January so far as the binding of books for the Forest Research Institute was concerned, and its activities were confined to departmental work. 2,616 maps of various sizes were mounted on cloth for issue.

Miscellaneous.—At the special request of the Conservator of Forests, Northern Circle, Central Provinces, and of the Divisional Forest Officer of the South Raipur Forest Division, the area statements of the reserved forest areas in 109 four-inch sheets were revised.

The re-indexing and the preparation of the list of all the forest triangulation and traverse data referred to in last year's report, could not be completed during the year, owing to a large number of loose computation records being found, entailing a great deal of labour in arranging, binding and labelling.

The Catalogue of maps published in 1916 by the Forest Map Office has been revised and sent to press.

III.—CIRCLE AND LOCAL DRAWING OFFICES.

58. No. 3 Drawing Office (Northern Circle).—During the year 24 two-inch sheets out of 26, 54 one-inch sheets out of 93 and 3 half-inch sheets out of 10 previously surveyed, were fair-mapped by parties and have been submitted for publication.

PERSONNEL
Class I Officer.
Mr. J. A. Freeman, in charge.
Class II Officers.
Mr. E. B. West.
,, A. A. Graham.
Upper Subordinate Service.
1 Officer.
Lower Subordinate Service.
49 Surveyors, etc.

Half-inch sheets compiled from one-inch sheets.—11 half-inch sheets were drawn in the Circle Drawing Office, and have been submitted for publication during the year.

Modern material available.—The fair-mapping of 15 half-inch sheets, of which the component two-inch and one-inch sheets have been published or sent for publication, is in hand. In addition to the above there are 19 half-inch sheet areas, of which some of the component two-inch or one-inch sheets though surveyed have not been published. The material for these areas will soon be available for half-inch mapping.

Quarter-inch sheets compiled from modern one-inch and half-inch sheets.—During the year 9 quarter-inch sheets were fair-mapped and submitted for publication.

Modern material available.—There are 8 quarter-inch sheets of which the component one-inch or half-inch sheets have been published, and the fair-mapping of all of these is in hand. There are, besides the above, 8 quarter-inch sheet areas of which the component two-inch, one-inch and half-inch sheets though surveyed have not been published.

Special maps.—During the year the Town-Guide map of Lucknow in 4 sheets, the Khaur Oil Fields map in three sheets on the sixteen and eight-inch scales respectively were prepared and submitted for publication.

The colour patterns of 5 Town-Guide, Environs, and Western Jumna Head Works maps, on the twelve-inch, four-inch and eight-inch scales respectively, were prepared and submitted for publication.

Hill-shaded sheets.—40 one-inch, half-inch and quarter-inch sheets were stump-shaded and submitted for publication.

Layer guides.—Nil.

Colour patterns and press order proofs.—Press order proofs and colour patterns of 98 sheets were submitted for publication.

Miscellaneous.—The traverse plots of "*mauzas*" in 4 sheets of Gondā district, on the sixteen and thirty-two-inch scales, and enlargements of Mawai and Baponi villages of Jhānsi district, on the sixteen-inch scale, were supplied, and the cost of preparation recovered from the Deputy Commissioners of Gondā and Jhānsi.

For the purpose of reprint the office copies of 4 sheets were corrected and submitted for publication.

Record Section.—Triangulation data for 12 degree sheets were completed but their final disposal has been delayed pending the issue of revised instructions for the preparation of triangulation pamphlets.

The staff of computers was considerably reduced during the year.

59. No. 4 Drawing Office (Southern Circle).—During the year 44 one-inch and 8 half-inch sheets previously surveyed and mapped, 1 one-inch sheet previously surveyed and partly resurveyed during the year and 9 one-inch sheets surveyed during the year were received from parties before the 30th September 1923 and were finally examined and submitted for publication. There are no arrears.

PERSONNEL.
Class I Officer.
Mr. J. O'B. Donaghey, in charge.
Class II Officers.
Mr. E. Claudius.
„ Haji Abdul Rahim, K.B.
Upper Subordinate Service.
4 Officers.
Lower Subordinate Service.
46 Draftsmen, etc.

Half-inch sheets compiled from modern one-inch sheets.—7 sheets were mapped and submitted for publication. There are 11 sheets in hand of which 1 will shortly be submitted for publication.

Modern material available.—The material for 3 half-inch sheets has been received but the mapping has not yet been commenced. In addition there are 11 half-inch sheet areas of which the component one-inch sheets have been submitted for publication but not yet published, and 11 half-inch sheet areas completely surveyed on the one-inch scale but of which all the component one-inch sheets have not yet been submitted for publication.

Quarter-inch sheets compiled from modern one-inch and half-inch and old style sheets.—8 sheets were mapped and submitted for publication. There are 7 sheets in hand of which 1 is ready for despatch.

Modern material available.—There are 4 quarter-inch sheet areas of which the component half-inch sheets have been submitted for publication, 6 quarter-inch sheet areas of which the component half-inch sheets

have not all been submitted for publication and 5 quarter-inch sheet areas completely surveyed but of which the mapping of the component half-inch sheets has not yet been commenced.

Reprint sheets.—The correction of 1 quarter-inch sheet was completed and the sheet was submitted for publication. There are no reprint sheets in hand.

Colour patterns.—Were prepared for 56 sheets and submitted for publication.

Hill-shaded sheets.—Were prepared for 44 sheets and submitted for publication.

Layer guides.—Nil.

Photo.-Zinco. work.—

Number of reproductions	318
,, ,, enlargements	135
,, ,, reductions	429
,, ,, vandyke plates prepared	263
,, ,, prints pulled	10,797

Work for private individuals on cash payment was done to the value of Rs. 135.

Special maps.—A four-inch military map of Būshire (Persia) was finally examined and submitted for publication. 8 two-inch sheets of the special forest survey of Hyderābād (Deccan) surveyed and mapped during the year have been finally examined and submitted for publication. 4 one-inch special forest sheets of the Indore State previously surveyed and mapped and 5 similar sheets surveyed and mapped during the year by No. 5 Party have been finally examined and submitted for publication.

The preparation of a road map of Bangalore on the three-inch scale is in hand.

Triangulation charts and computations.—Seven triangulation pamphlets and charts were prepared during the year and are ready for despatch to the Superintendent of the Trigonometrical Survey when called for by him. Material was extracted and supplied to (*a*) the parties of this circle, (*b*) the Northern Circle and (*c*) the Land Records of the Bombay Government. Material was also extracted and supplied to a private individual on cash payment to the value of Rs. 47. The work of revising the register of all triangulation and traverse records in this office is in hand.

Miscellaneous.—Preparation of Index maps, etc. The work of sorting and arranging all records and copies of published sheets in the office was taken in hand.

Published copies of sheets were sold to the public to the value of Rs. 273.

60. No. 5 Drawing Office (Eastern Circle).—The following

PERSONNEL.

Class I Officer.
Mr. W. M. Gorman, in charge.

Class II Officer.
Mr. P. Simpson.

Upper Subordinate Service.
3 Officers.

Lower Subordinate Service.
31 Surveyors, etc.

sheets were received from field parties during the year:—

Scale 4 inches to 1 mile ...	1
„ 2 „ „ „ ...	4
„ 1 inch „ „ ...	37
„ ½ „ „ „ ...	9
Total ...	51

Of the above, 1 two-inch sheet was returned to the Superintendent, Burma Circle for entry of boundaries and 50 sheets were submitted for publication.

8 of the half-inch sheets required completion to edge from old surveys in the Drawing Office.

Half-inch sheets compiled from modern one-inch and old style sheets.—During the year, 21 sheets were in hand, including 5 from last year; of these 11 were submitted for publication and 10, which were begun towards the close of the recess, remain in hand.

Modern material available for half-inch mapping.—All sheets of which the component 1-inch sheets are published have been put in hand and the material for 4 half-inch sheets, whose component 1-inch sheets are under publication, has been applied for.

Quarter-inch sheets compiled from modern one-inch, half-inch and old style sheets.—Five sheets were in hand, of which four were submitted for publication, leaving one recently begun sheet in hand.

Modern material available for quarter-inch mapping.—All ¼-inch sheets of which the component ½-inch sheets are published have been put in hand and material for one sheet, of which the component ½-inch sheets are under publication, has been applied for.

Hill shaded sheets.—3 sheets were prepared and submitted. There are no arrears.

Layer guides.—None were received during the year.

Colour patterns and press order proofs.—Those of 68 sheets were received and dealt with and, in addition, 6 sheets were prepared for reprint purposes.

61. * Maymyo Drawing Office (Burma Circle).—32 sheets were surveyed by parties of the Burma Circle during the year. Of these, 7 two-inch sheets were fair-mapped and received in the office before the 30th September. The remainder, *viz.*, 10 two-inch, 12 one-inch and 2 half-inch sheets are expected before the 30th October.

PERSONNEL.
Class II Officer.
Mr. F. J. Grice.
Upper Subordinate Service.
1 Officer.
Lower Subordinate Service.
17 Draftsmen, etc.

Half-inch sheets compiled from modern one-inch sheets.—Six of these sheets are in hand; 2 have been submitted for proofs and 4 remain in hand.

Modern material available for half-inch mapping.—There are 2 modern half-inch sheets, of which the component one-inch sheets have been published, the drawing of which has not yet been put in hand.

Quarter-inch sheets compiled from modern one-inch and half-inch sheets.—None in hand.

Modern material available for quarter-inch mapping.—There is 1 quarter-inch sheet of which the component half-inch sheets have been published and the drawing of which has not been taken up.

Two-inch Forest sheets.—Two have been completed, leaving no arrears.

Colour patterns and press order proofs.—These have been received for 1 sheet and completed and submitted for 1 sheet.

Forest Index showing Gazetted Reserves.—This Index is being prepared, on the one million scale, from material taken from one-inch, half-inch and quarter-inch sheets and from that received from the Forest Department. It will show all information regarding Forest Reserves both surveyed and unsurveyed and will supersede the existing 32-mile index which is on too small a scale to be of much utility.

62. No. 6 (Simla) Drawing Office.—The *Survey Section* has been employed on the compilation and fair-drawing of trans-frontier maps on the one-millionth, half-inch and quarter-inch scales, and incorporating additional survey and information on sheets previously published.

PERSONNEL.
Class I Officer.
Major L. G. Crosthwait, I.A., in charge.
Class II Officers.
Mr. R. E. M. Saubolle.
,, F. H. Grant.
,, H. H. P. Butterfield.
4 European Draftsmen.
26 Indian Draftsmen, etc.

* This office was not constituted as a separate charge during the year.

During the year 23 quarter-inch sheets and 2 half-inch sheets were fair-drawn and submitted for publication and 4 quarter-inch sheets were sent for re-publication after new material and information had been added.

The *Army Section* is employed on the preparation and printing of maps and plans for the Army and other Government Departments.

During the year 222 maps and plans were dealt with and 63,027 copies printed on the litho-printing presses.

63. Bengal and Bihar and Orissa Drawing Office.—(Imperial Standard Mapping Section).—This section has been employed on the fair-mapping of the preliminary editions of modern 1-inch sheets in colours, compiled from modern revenue survey material and completed from old material where no modern work is available.

PERSONNEL.

Class II Officers.

Mr. C. West, in charge from 14th June 1923.

Mr. A. B. Hunter, in charge to 13th June 1923.

Upper Subordinate Service.

1 Officer.

17 new sheets of Bengal, 8 new sheets of Bihar and Orissa and one degree sheet (preliminary edition) were fair-mapped and submitted for publication during the year.

As an experimental measure 4 one-inch sheets were drawn in colours; by this method it is hoped that the preparation of colour patterns for the Photo.-Litho. Office will be unnecessary. In addition an area of 169 square miles in the Raniganj coal field area was reduced from modern revenue material for supplementary survey on the 4-inch scale by No. 4 Party in 1923-24.

The administrative control of the section was transferred from the Director of Surveys, Bengal to the Superintendent, Map Publication from 1st August 1923

PART 4.—WORK FOR OTHER GOVERNMENT DEPARTMENTS.

64. Northern Circle. No. 4 Party.—A dispute having arisen over the boundary between Pāra and Basantpur villages in Bāra Banki and Gondā districts, due to many consecutive trijunction pillars having been washed away by the Gogrā river, the services of an officer of the department were called for and furnished. A new boundary, 2,610 yards in length, was demarcated, the survey being based on trijunction pillars at some distance from the disputed area. The expenditure incurred was recovered from the civil authorities.

65. No. 22 (Riverain) Party.—The party continued the work of traversing and laying down base lines. 959 linear and 970 square miles of main-circuits along the Indus river in the districts of Muzaffargarh, Dera Ismail Khān and Dera Ghāzi Khān and along the Chenāb and Jhelum rivers in Jhang district and 2,960 linear miles and 627 square miles of minor traverse in the Indus riverain tract in Muzaffargarh district were executed, 1,304 theodolite stations of the former and 13,374 of the latter in 90 villages were fixed. 21 corners of 7 squares in 17 square miles were demarcated with permanent mark-stones on both banks of the Indus river in the districts of Muzaffargarh, Dera Ismail Khān and Dera Ghāzi Khān to serve as bases for future survey and demarcation of boundaries and fields in the bed of the river. 1,554 plotted and 476 boundary *mâsāvis* (settlement mapping sheets) on the scale of 1/2,640 and 40 four-inch sheets were traced and supplied to the Settlement Officer, Muzaffargarh. Besides these, 264 boundary *masāvis* were partly compiled on the scale of one inch = 220 feet for the next season's work, and 273 miscellaneous traces were prepared; all the traverse stations marked during the field season were plotted on 42 four-inch sheets.

PERSONNEL.

Class II Officer.

Mr. Dhani Ram Verma, R.S., in charge.

Upper Subordinate Service.

4 Officers.

Lower Subordinate Service.

33 Traversers, etc., (excluding 19 purely temporary men).

Boundary Survey.—This work consisted in a plane-table survey of the boundaries of the newly constituted tahsils of Siālkot district. For this the original field sheets of the area topographically surveyed on the one-inch scale in the years 1910—12 were used. 135 linear miles of the new boundaries were surveyed by interpolation and measurement from the surrounding detail and village trijunction pillars

shown on the original field sheets. The work was commenced on the 17th July and finished on the 14th September, the heavy monsoon rains having seriously retarded its progress.

66. No. 23 (Punjab Rectangulation) Party.—During the year the party was employed on rectangulation in connection with the Punjab Government's Sutlej Valley project in the districts of Multān, Montgomery, Lahore and Ferozepore and in Bahāwalpur State.

PERSONNEL.
Class I Officer.
Major R. Foster, I.A., in charge.
Class II Officers.
Mr. Maya Das Puri, R.S.
„ A. M. Talati, L.C.E.
„ C. O. Picard.
„ F. W. Smith.
„ D. N. Banerjee, L.C.E.
Upper Subordinate Service.
3 Officers (excluding one Supervisor on purely temporary establishment).
Lower Subordinate Service.
18 Traversers, etc., (excluding 133 purely temporary men).

A total area of 4,152·7 square miles was rectangulated, 26,554 100-acre rectangles were laid out, and 26,378 corner stones of 100-acre rectangles were embedded. An area of 7,250 square miles or 5,844 linear miles was traversed in advance for the purpose of laying down the main corners of 2,400-acre rectangles and an area of 1,208 square miles was triangulated to supplement this traverse.

The country under rectangulation lies on both sides of the Sutlej river from Ferozepore on the north-east to the boundary of Sind on the south-west; it is bounded on the north-west by the Indus and Chenāb rivers and the old bed of the Beās river and on the south-east by the dry bed of the Ghaggar river and by Bīkaner State. Near both banks of the Sutlej and in the north-east portion of the area the country is well cultivated and fed by inundation canals; to the north is a large tract of level country covered by scrub jungle where water is scarce in parts and brackish; the southern portion consists of sandy desert in which wells of brackish water occur at long intervals although, during the first half of the winter, a few "*tobas*" or depressions are found filled with rain water.

In recess the party was employed on compilation of "*masavis*" of the area rectangulated, traverse computations and preparation of materials for the ensuing field season.

67. Southern Circle. No. 5 Party.—At the request of the General Staff, Mhow, triangulation was carried out over an area of 115 square miles round Mhow cantonment to give points for artillery ranging purposes.

68. Eastern Circle.—In addition to his duties in the Imperial Department, the Superintendent, as Director of Surveys, Assam, held administrative charge of the Assam Survey Department, including the Assam Traverse Party, Drawing Office and Reproduction Office and the Assam Survey School.

69. Burma Circle. No. 10 Party.—At the request of the Coalfields of Burma, Ltd., one Upper Subordinate officer was sent on deputation to the Upper Chindwin district to survey the coal area near Kalewa belonging to the Company.

Work was begun in May and completed in July. The area was 149·52 acres which was surveyed on the scale of 100 feet to 1 inch with contours at 10 feet intervals. The traverses were connected to points of minor triangulation in the neighbourhood. A trace was made of the work and copies were vandyked by the Government Printing Press, Rangoon.

The whole cost amounting to about Rs. 2,000 was borne by the Coalfields of Burma, Ltd.

70. No. 11 Party.—At the request of the Superintending Engineer, Mandalay Circle, the survey of one square mile of the Maymyo Residential Area was undertaken on the scale of 32 inches to one mile, with contours at 5 feet vertical intervals.

71. Trigonometrical Survey.—At the request of the Punjab Government, No. 17 Party ran 1,269 miles of secondary levelling in connection with the Sutlej Valley Irrigation project, for which, in addition, 13,889 miles of tertiary levelling, covering 2,045 square miles, was done (*vide* page 28). The preparation and printing of contoured charts for the same project was begun.

For the Bombay Government, 208 miles of levelling were run, to give heights to Irrigation bench-marks in the Ghatprabha area in Dhārwār. 392 miles of double levelling were also executed for the Sukkur Barrage project, (*vide* page 29).

For the Burma Government, (P. W. D., Irrigation), 610 miles of levelling were executed, (*vide* page 29).

The cost of levelling in all these cases was borne by the Local Governments concerned.

72. At the instance of military authorities, Mr. Jugal Behari Lal, Sub-Assistant Superintendent, was sent to undertake special triangulation over several artillery practice camp areas.

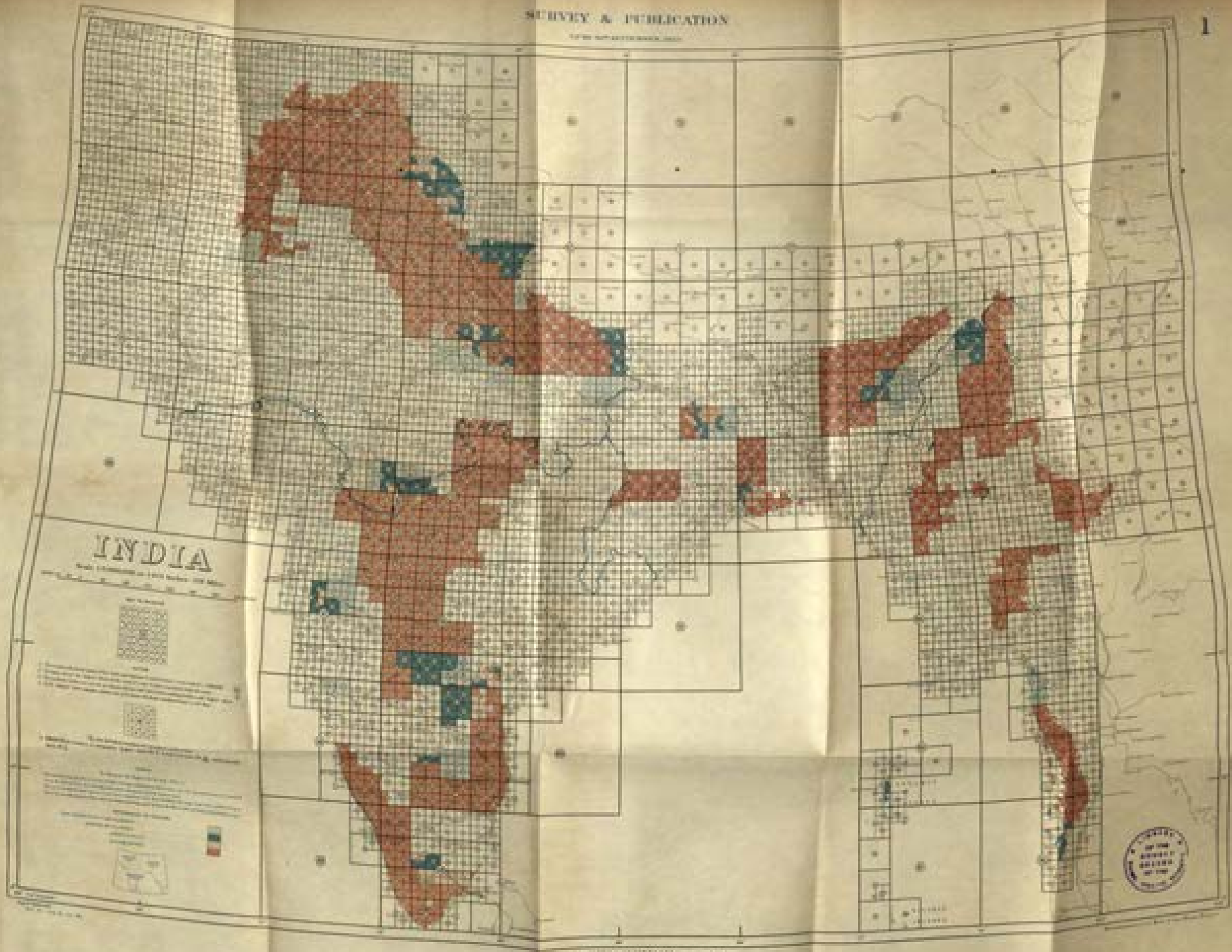
73. Head Quarter Offices.—The total out-turn of all extra-departmental publications during the year for the Army, for Local Governments and for other government offices are given in Table A of the Photo-Litho. Office report on page 43, in the "Issues" table and in Table III of the Map Record and Issue Office report on pages 35 and 36.

In addition to the special maps for other departments which are mentioned in para. 49(*g*) on page 34, these extra-departmental publications include maps to illustrate the various reports of government officials, maps for railway guides, and for posting in railway carriages, &c. The usual large numbers of weather charts for the Meteorological Department and of the photogravure and half-tone illustrations for the Archæological and other departments were also printed.

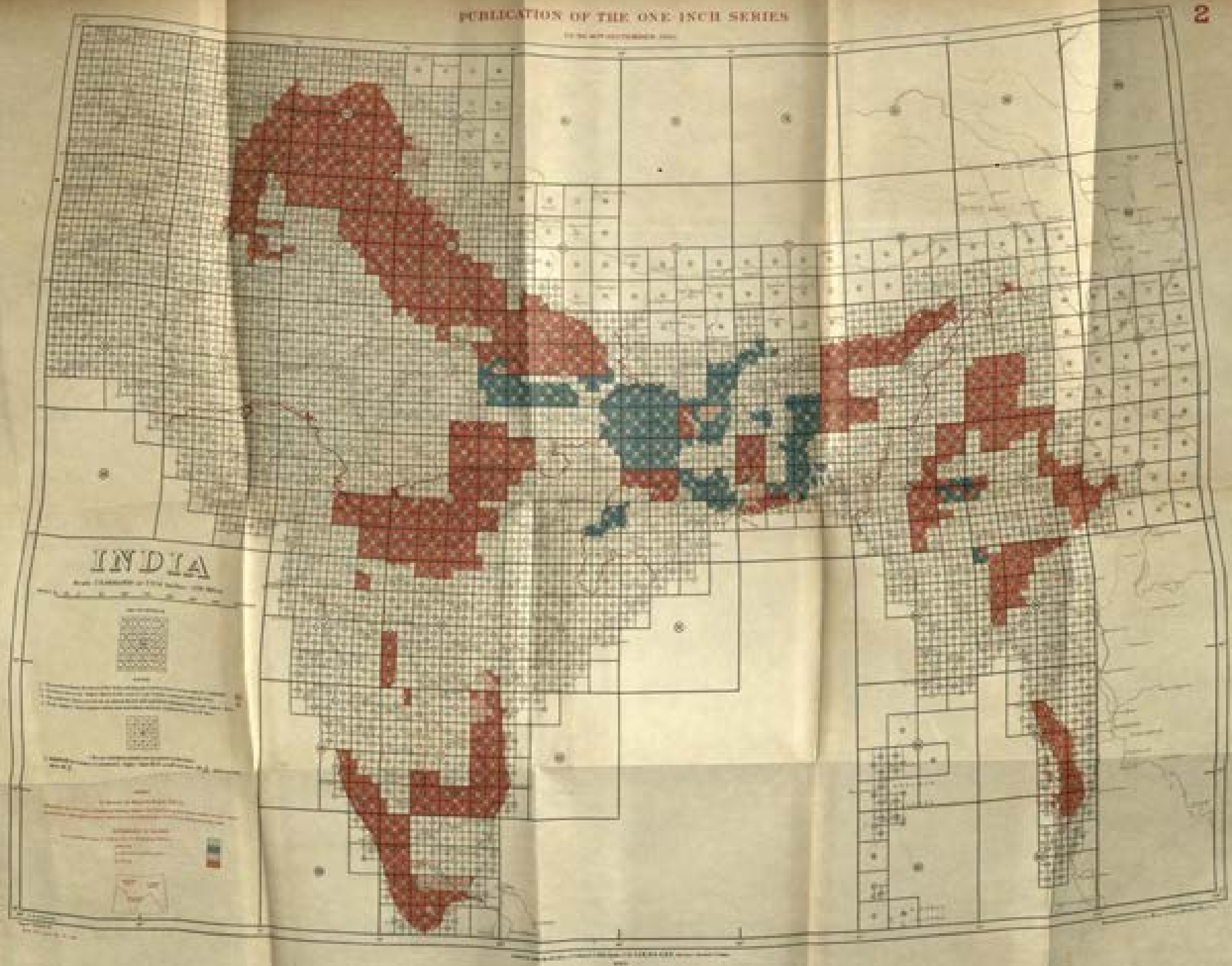
The work entailed by the preparation of originals for some of these special maps, in addition to their publication, is mentioned in the reports of No. 1 Drawing Office and of the Engraving Office on pages 37 to 42.

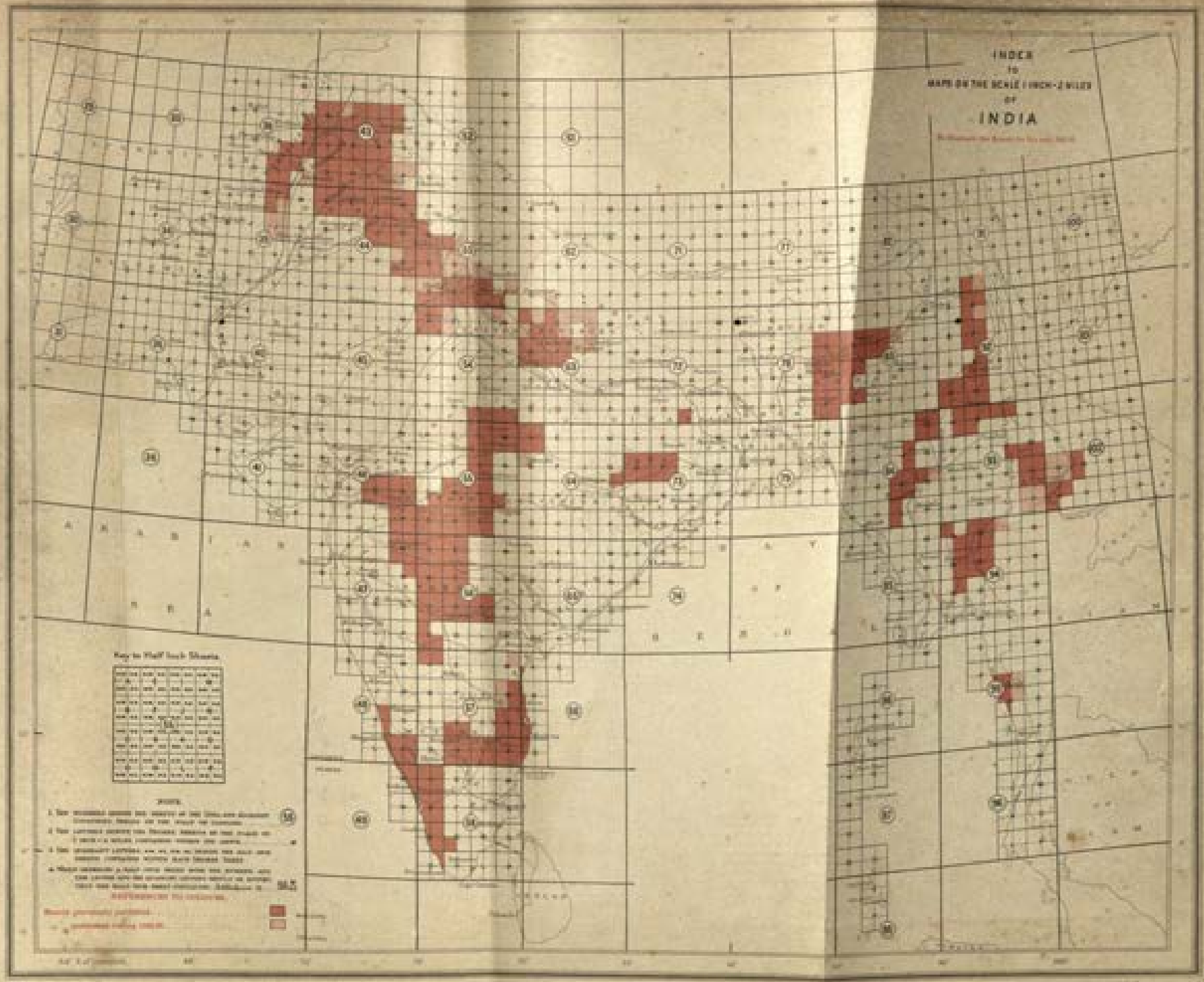
74. Mathematical Instrument Office.—Repairs to range-finders, binoculars, telescopes, sight dials and directors, &c., and a certain number of manufactures were carried out for the military departments as usual. General repair and manufacture work for civil departments is well up to date.

75. No. 6 (Simla) Drawing Office.—In addition to its normal work for the Army, this office has prepared maps and plans for the Archæological, Foreign and Political, Home and Legislative Departments, Census Commissioner, Indian States Forces, 2nd Bombay Pioneers, Indian Army Ordnance Corps Magazine, Army Sports Central Board, Public Health Commissioner and Royal Air Force.

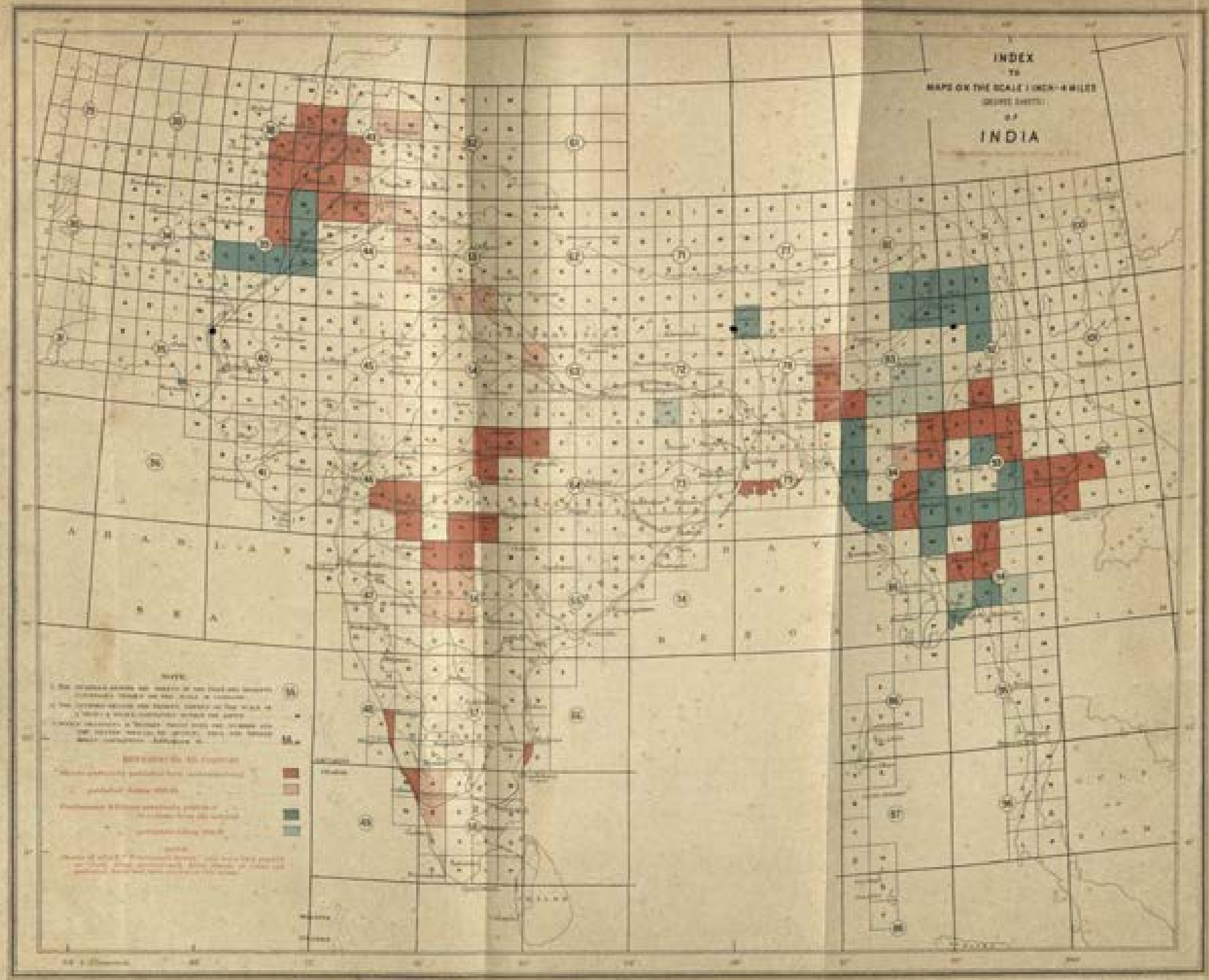

INDIA

PUBLICATION OF THE ONE INCH SERIES




INDEX
TO
MAPS ON THE SCALE 1 INCH = 2 MILES
OF
INDIA
Key to Half Inch Sheets

HALF INCH SERIES


INDEX
TO
MAPS ON THE SCALE 1 INCH = 4 MILES
(SHEET)
OF
INDIA

DEGREE SHEET SERIES

Scale 1 Inch to ¼ Miles.

4

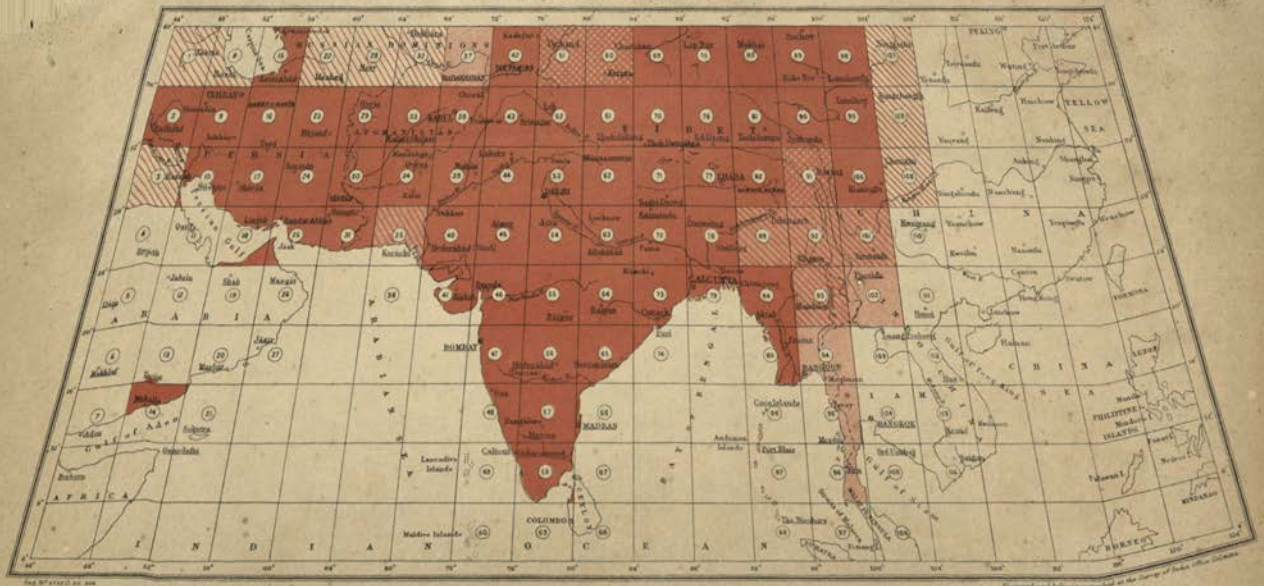
DEGREE SHEET SERIES

Scale 1 Inch to 4 Miles.

INDEX TO THE SHEETS OF THE

INDIA AND ADJACENT COUNTRIES SERIES

on the Scale of 1/1,000,000 or 1·014 inches to 16 miles.



NOTE.

The names underlined on this Index are the title names of the sheets, and their numbers are shown in circles. Sheets 35 and 36, 57 and 66, are published respectively as combined sheets.

Scale 1/1,000,000

Miles 0 20 40 60 80 100 120 140 160 Miles

REFERENCE

To illustrate the degree of the completion of these published sheets, coloured 3 tones, with contours 3 tones, hachures, hill shading.

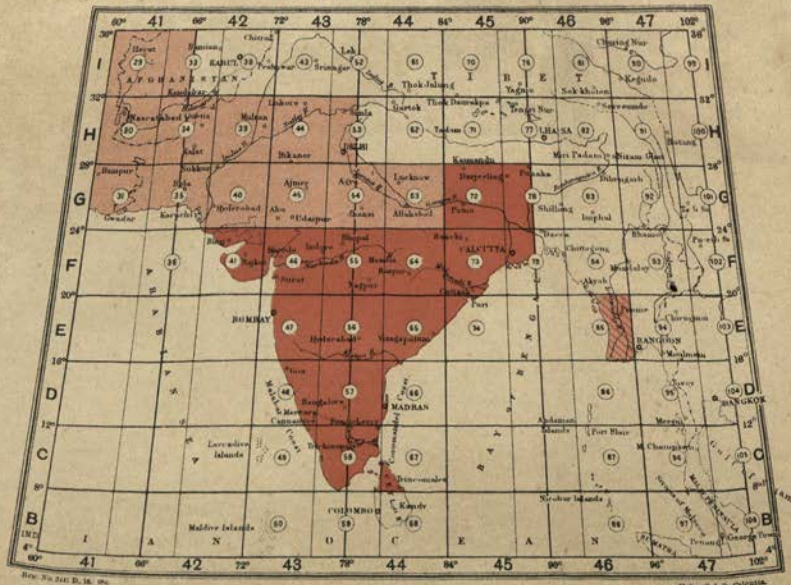
INDIA AND ADJACENT COUNTRIES SERIES

Scale 1:1,000,000.

INDEX TO THE SHEETS OF THE

CARTE INTERNATIONALE DU MONDE

on the Scale of 1:1,000,000.



Rep. No. 3141 D. 16. 26c.

Helio., S. I. O., Calcutta.

EXPLANATION.

The thick lines show the margins of the sheets of the International Map of the World, Scale 1:1,000,000. Each sheet is designated by the letter N (Northern hemisphere), followed by the marginal letter and number corresponding to its position, e.g., the sheet which includes Bombay is N.M.43.

The figures in circles are the numbers of the sheets of the India and Adjacent Countries Series on the Scale of 1:1,000,000.

Scale 70 miles to one inch.

Miles 200 0 200 400 600 800 1000 Miles

REFERENCE.

Sheets published

" under publication

" in hand

To illustrate the Report for the year 1922-23.

6.

6

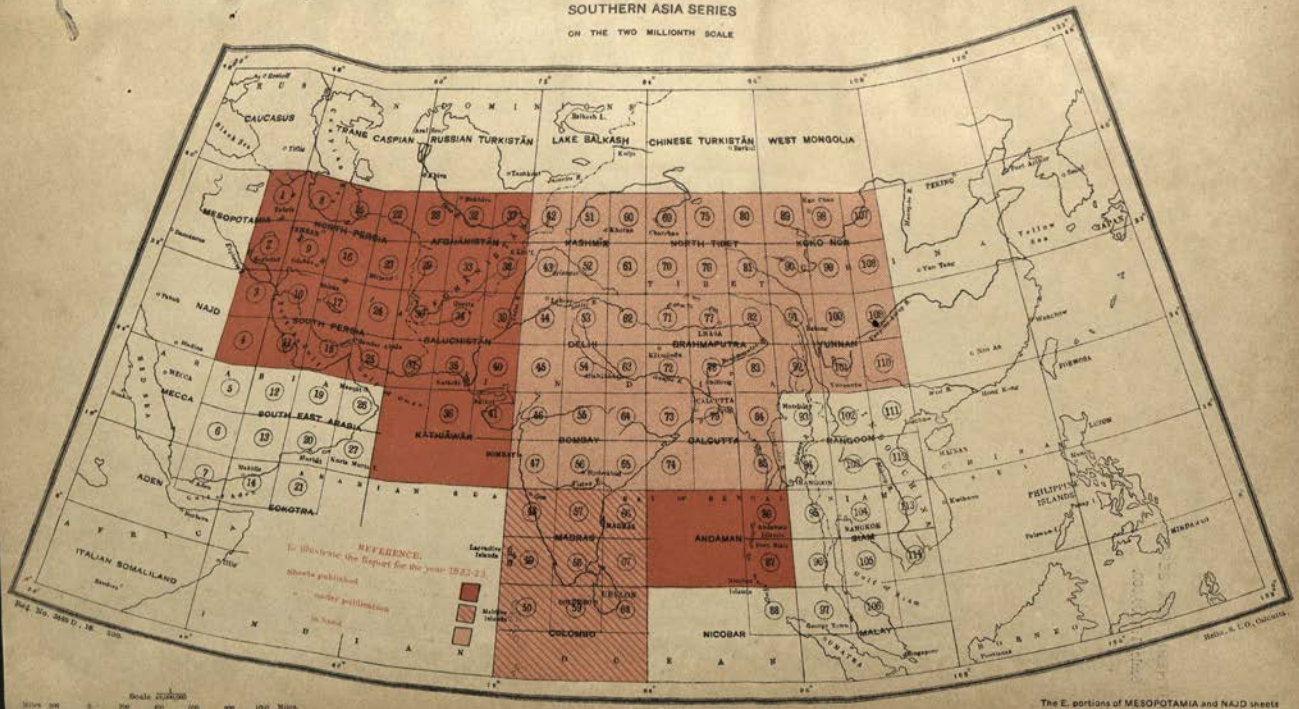
INTERNATIONAL SERIES

Scale 1:1,000,000.

INDEX TO THE SHEETS OF THE

SOUTHERN ASIA SERIES

ON THE TWO MILLIONTH SCALE



The E. portions of MESOPOTAMIA and NAJD sheets have been published for the present as outriggers to N. & S. PERSIA sheets respectively.

7

SOUTHERN ASIA SERIES

Scale 1:2,000,000.

Photogravure

Survey of India Offices, Calcutta, 1924.

COLONEL CHARLES HENRY DUDLEY RYDER, C.B. C.I.E. D.S.O. R.E.

Surveyor General 1919–1924.

Survey of India.

GENERAL REPORT

FOR 1923-24.

From 1st October 1923
To 30th September 1924.

PREPARED UNDER THE DIRECTION OF

Colonel E. A. TANDY, R.E.,

SURVEYOR GENERAL OF INDIA.

Printed at the Photo.-Litho. Office,
Survey of India,
CALCUTTA,
1925.

PRINTED AT THE
PHOTOGRAPHIC AND LITHOGRAPHIC OFFICE, SURVEY OF INDIA.
14, WOOD STREET,
CALCUTTA.

NOTICE.

MAPS PUBLISHED BY THE SURVEY OF INDIA

are obtainable from the Map Record and Issue Office, 13, Wood Street, Calcutta, on the Public Service—on Cash Payment or Book-Transfer, and, for private use—on Cash Payment or V. P. P.

Forest maps are obtainable only from the Officer in charge, Forest Map Office, Dehra Dun.

Geological maps are obtainable from the Director, Geological Survey of India, Calcutta.

The Survey of India publish maps for the greater part of SOUTHERN ASIA between the meridians of 44° and 124° East of Greenwich and between parallels 4° and 40° north latitude.

2. Surveys executed after 1905 are classed as "MODERN", those prior to that date are classed as "OLD".

3. Maps are printed in two styles or editions *viz.*, LAYERED and POLITICAL:—

(*a*) The LAYERED edition represents a map printed in colours with graduated layer tints of colour to show altitudes, and, shading to emphasize the hills. This edition gives prominence to the physical features.

(*b*) The POLITICAL edition represents a map printed in colours, but without graduated layer tints. Hills are represented by contours and shading. This edition gives prominence to the Civil Divisions of India which are shown by ribands of colour along boundaries of administrative partitions.

NOTE.—When maps are printed in colours, from mixed or old surveys, the edition is styled "PRELIMINARY"; and when published in black only or with hills in brown, the edition is styled "PROVISIONAL" issue.

4. The series of Modern maps are grouped under three Divisions:—

(I) GEOGRAPHICAL, embracing—

(*a*) SOUTHERN ASIA SERIES, scale 1:2,000,000 or nearly 1 inch = 32 miles, in LAYERED and POLITICAL editions, size 36 inches x 24 inches, price Rs. 3 per copy.

(*b*) INDIA AND ADJACENT COUNTRIES; scale 1:1,000,000 or nearly 1 inch = 16 miles, in LAYERED and POLITICAL editions, or if from old surveys, as PRELIMINARY editions; size 24 inches x 19 inches, price Re. 1-8 per copy.

NOTE.—When the Layered edition is not published or out of print, the Political edition is sent, and *vice versa*.

(*c*) INTERNATIONAL MAP OF INDIA, scale 1:1,000,000 or nearly 1 inch = 16 miles, in LAYERED edition (without shading of hills), size 30 inches x 26 inches, price Re. 1-0 per copy.

(II) TOPOGRAPHICAL, comprising maps on:—

(*a*) SCALE 1 INCH = 1 MILE, in the POLITICAL edition, size 24 x 19 inches, price Re. 1-8 per copy.

(*b*) SCALE 1 INCH = 2 MILES, in the POLITICAL edition, size 24 x 19 inches, price Rs. 3-0 per copy.

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NOTE.—Modern Topographical maps printed on linen-backed paper are As. 12 extra per copy. Index charts or Key maps to the Geographical and Topographical series are obtainable gratis.

(III) GENERAL MAPS which include:—

(*a*) GENERAL MAPS OF INDIA, scale 1 inch = 32 miles, in sets of 12 sheets, each sheet 25 x 32 inches, in LAYERED and POLITICAL editions, price Rs. 12 per set, and on scale 1 inch = 64 miles, POLITICAL edition only, size about 3½ feet square, at Rs. 6 the copy. Also various maps of India on the same and smaller scales and miscellaneous special maps illustrating Railways, &c.

(*b*) PROVINCIAL MAPS, on scales 1 inch = 16 miles and 1 inch = 32 miles.

(*c*) DISTRICT MAPS, on scales 1 inch = 4 miles and 1 inch = 8 miles.

(*d*) CANTONMENT AND TOWN MAPS AND OTHER MISCELLANEOUS MAPS, of various scales and prices.

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6. Maps can be mounted on cloth and folded or mounted on rollers for hanging, &c., at an extra charge.

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4. ,, ,, quarter-inch ,, ,,
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6. ,, Indian sheets of "La Carte Internationale du Monde," scale $\frac{1}{1,000,000}$.
7. ,, 'Southern Asia' series, scale $\frac{1}{2,000,000}$.

Survey of India.

GENERAL REPORT,

1923—24.

From 1st October 1923
To 30th September 1924.

PART 1.—GENERAL REMARKS.

I.—INTRODUCTION.

1. The main parts of this report, as shown in the "Contents" on the opposite page, are *Part 2—Work of Field Parties, &c.*, summarising the operations of the field parties, grouped under appropriate headings; and *Part 3—Office Work*, which gives a brief account of the year's progress in the head-quarters and other offices.

2. An abstract showing the progress of the topographical programme assigned to the department in 1905, will be found in Table I on page 5. From this it will be seen that the out-turn of topographical survey during the current year was 65,673 square miles; and that this brings the total progress since 1905 to 753,890 square miles, leaving 1,067,710 square miles still to be done.

3. The first Index map, at the end of the report, shows the progress of the topographical programme both in survey and in publication, while the remaining six indexes show the progress in publication of the various series of maps appertaining to the scheme.

4. Table III on page 38 gives a list of the new publications of the Calcutta Offices during the year. Lists of new maps are published monthly.

5. The main events of the year are summarised below:—

(*a*) His Excellency the Viceroy paid a short visit to the Head-quarters Offices, Calcutta, on the 18th December 1923.

(*b*) There was a further increase in the out-turn of the topographical survey, 65,673 square miles being completed. This was due to the inclusion of an unusually large proportion of half-inch survey and revision survey.

(*c*) The geodetic operations were partially resumed, observations of the intensity and direction of gravity (pendulum and latitude) being taken up.

(*d*) Aero-photo surveys were undertaken in the Irrawaddy Delta and in Waziristān.

(*e*) There was a decrease in the issue of maps to Government officials; the issues to the public, however, showed a steady increase.

(*f*) Detachments were sent to the Khyber and Tānk on the N. W. Frontier.

(*g*) Surveyors were deputed to accompany the Deputy Commissioner, Nāgā Hills, the Mount Everest Expedition, and the Chitrāl Reliefs. Their services were greatly appreciated.

(*h*) A map reproduction staff was lent early this year to work with the Anglo-Persian Oil Co., Ltd., Muhammareh.

The survey detachment which was lent to them in September 1923 returned to India in June 1924.

(*i*) Two upper subordinate officers were deputed to assist the Burma Oil Co., Ltd., on the gravity survey with the Eötvös torsion balance in Sind. Their assistance was much appreciated.

(*j*) The Waziristān Survey Detachment was disbanded in June 1923.

(*k*) A considerable amount of minor work was done in connection with Artillery Survey. Short courses of instruction to Artillery officers were held and the fixing of points in some artillery practice camps was carried out.

(*l*) A conference was held at the Geodetic Branch Office in October 1923, and again at Delhi in April 1924, to discuss the question of co-operation between the Royal Artillery and the Survey of India in peace and war. As a result the surprinting with a one-minute mesh of modern topographical maps for military use was introduced to facilitate map references. This mesh differs from the "grid" used in England in being a sub-division of the spherical graticule.

(*m*) The branch map issue office at No. 5, Esplanade East, Calcutta, was removed permanently to the Government Central Book Depôt, No. 8, Hastings Street, Calcutta.

(*n*) The Trigonometrical Survey of the Survey of India is now designated the Geodetic Branch of the Survey of India, and the title of Director was adopted for officers in administrative charge of circles, &c.

(*o*) The Maymyo Drawing Office and the Northern Circle Office were made into executive charges, the former being designated No. 7 Drawing Office; the number of executive charges reserved for Class II officers was thus raised from 11 to 13, of which 4 are temporary for the present.

II.—ADMINISTRATION AND PERSONNEL.

6. The actual cost of the department for the financial year ending 31st March 1924 and of the two previous years is shown below:—

	1921-22.	1922-23.	1923-24.	REMARKS.
	Rs.	*Rs.*	*Rs.*	* Includes an unusual charge of over Rs. 9,00,000 debited to the department on account of Europe stores. † These figures are not final.
Gross actual cost ...	62,01,542	54,30,867	51,06,338†	
Deduct receipts and credits	19,38,588	25,20,447	21,26,831†	
Net actual charges ...	42,62,954	29,10,420	29,79,507†	

7. Colonel C. H. D. Ryder, C.B., C.I.E., D.S.O., R.E., administered the department up to 27th March 1924 when he proceeded on leave preparatory to retirement, and was succeeded by Colonel E. A Tandy, R.E.

8. *Class I Officers*:—Colonels C. H. D. Ryder, C.B., C.I.E., D.S.O., R.E., and W. M. Coldstream, C.I.E., R.E., retired. A summary of Colonel Ryder's distinguished services is attached as an appendix to this report.

Mr. E. G. Hardinge who is on deputation with the Government of Assam, and Messrs. Hanuman Prasad, R.S., and Dhani Ram Verma, R.S., were promoted temporarily from the Class II Service.

Mr. T. A. Ferrier, O.B.E., Officer in charge, Mathematical Instrument Office, retired.

Class II Officers:—Mr. Asmat-ullah Khan, K.B., retired.

Captain V. P. Wainright was placed on foreign service with the Rangoon Development Trust; Mr. W. H. Strong, M.B.E., who had been on foreign service with the 'Iraq Government was placed on foreign service with the Anglo-Persian Oil Co., on the 23rd September 1923.

Messrs. J. McCraken, M.B.E., and A. F. Murphy reverted from foreign service with the Anglo-Persian Oil Co. Mr. N. N. Chuckerbutty reverted from deputation under the Government of the United Provinces.

Captain F. E. R. Calvert who resigned his appointment in February 1920 was reappointed.

Mr. Chuni Lal Kapur was promoted from the Upper Subordinate Service.

Messrs. Seth Ram Gupta, B.A., J. C. Berry, T. M. C. Alexander, and Muhammad Nazir Ahmad Hashmi, B.A., were appointed during the year.

Upper Subordinate Service:—Mr. Sarat Kumar Mukerji retired, Messrs. Gopal Lal Mitra and Mauji Ram Sharma and three probationers resigned. Messrs. Sher Jang, K.B., and Sijawal Khan reverted from foreign service with the Anglo-Persian Oil Co. Four officers were promoted from the Lower Subordinate Service.

Total strength of the department at the close of the Survey year was 55 Class I, 93 Class II and 78 Upper Subordinate officers, besides specialists, clerks, lower subordinates and menials.

9. No. 4 Party was placed under the administrative control of the Director, Eastern Circle, on the 1st October 1923.

On suspension of magnetic operations, except at the Dehra Dūn observatory, the designation of No. 18 (Magnetic) Party was changed to No. 18 (Aero-Photo) Party, and the party was placed under the administrative control of the Director, Burma Circle, on the 1st April 1924.

No. 20 (Cantonment) Party was transferred to the administrative control of the Director, Northern Circle, on the 1st September 1924. The designation of the party was changed to No. 20 (Cantonment and Special Surveys) Party, the party having taken up a special 4-inch survey of certain parts of the lower Sutlej Valley, Punjab, in connection with the Sutlej Irrigation scheme.

An independent detachment, designated the Settlement Survey Detachment, was formed on the 1st June 1924 for settlement survey operations in the Peshāwar and Attock districts.

10. The following honours and rewards were conferred during the year:—

Companion of the Order of the Indian Empire ... Colonel W. M. Coldstream, R.E.
Special Silver MacGregor Memorial Medal for 1923 ... Surveyor Hari Singh Thapa.
Volunteer Long Service (Silver) Medal ... ... Mr. C. F. Oddy, (Sergeant, Auxiliary Force, India), Offg. Manager, Photo., Photo.-Litho. Office, Calcutta.

Mr. B. T. Wyatt, Extra Assistant Superintendent, was promoted to the rank of Lieutenant in the Auxiliary Force.

PART 2.—WORK OF FIELD PARTIES, &c.

I.—TOPOGRAPHICAL SURVEYS.

11. The two following tables show respectively the progress of the topographical programme assigned to the department in 1905 and the out-turns and costs of different parties during the year under report. They are followed by brief descriptions of the work of each topographical party.

In 1913, the Secretary of State sanctioned a scheme for the reduction of the scale of survey of certain sparsely populated areas of India. This will greatly reduce the area of survey on the one-inch scale and consequently accelerate the rate of progress of topographical surveys shown in Table I below. In order to give a better idea of what work actually lies before the department, it may be remarked that of the area remaining for survey about 500,000 square miles are likely to be surveyed on the half-inch or smaller scales.

Table I.—Progress of Topographical Surveys since 1905.

Survey year.	Scales of Survey.	Northern Circle.	Southern Circle.	Eastern Circle.	Burma Circle.	TOTALS.
		Sq. miles.	*Sq. miles.*	*Sq. miles.*	*Sq. miles.*	*Sq. miles.*
1905-13	Mostly 2-inch and 1-inch.	150,356	80,310	27,551	57,042	315,259
1913-14	Mostly 1-inch and ½-inch.	25,052	15,844	7,291	7,599	55,786
1914-15	ditto.	12,334	19,286	2,448	2,608	36,676
1915-16	ditto.	8,168	17,243	2,279	4,652	32,342
1916-17	ditto.	11,689	11,338	3,560	6,163	32,750
1917-18	ditto.	4,202	12,181	3,596	4,800	24,779
1918-19	ditto.	509	7,263	1,764	4,412	13,948
1919-20	ditto.	9,145	11,891	4,311	5,117	30,464
1920-21	ditto.	14,411	14,275	5,766	5,509	39,961
1921-22	ditto.	11,528	21,596	5,970	5,510	44,604
1922-23	ditto.	26,199	20,823	9,144	5,482	61,648
1923-24	ditto.	18,544	28,160	11,363	7,606*	65,673
Total areas completed to date.		292,137	260,210	85,043	116,500	753,890
Approximate areas for the whole topographical programme.		750,000	542,800	262,925	265,875	1,821,600
Approximate areas remaining for survey.		457,863	282,590	177,882	149,375	1,067,710

* Excludes 10 square miles surveyed in 1922-23 on 1-inch scale and 1,440 square miles of original air-photo. survey on 3-inch scale.

Table II.—OUT-TURNS of PLANE-TABLING and COSTS of Topographical Surveys, 1923-24.

Party and Locality. Character of Country.	Scale and Class of Survey.	Out-turns of Plane-tabling. Areas on each Scale of each Class.	Out-turns of Plane-tabling. Totals of areas on all Scales.	Costs of Survey including Mapping. Total Costs.	Costs of Survey including Mapping. Cost-rates.	Remarks.
		Sq. miles.		*Rs.*	*Rs. per sq. mile.*	
NORTHERN CIRCLE.						
No. 1 Party—*United Provinces and Central India.*						
Undulating hills densely wooded.	**Half-inch** Revision Survey ...	2,163				
Cultivated plains, congested with villages, and low hills thinly wooded.	**One-inch** Revision Survey ...	4,268	6,462	89,642	13·9	
Allahābād & Environs.	**Four-inch** Revision Survey ...	31				
No. 2 Party—*Central India, Gwalior, Rājputāna and United Provinces.*						
Jungle clad hills, undulating forests, and cultivated plains.	**Half-inch** Original Survey ...	8,363				
Jungle-clad hills and cultivated plains.	**One-inch** Resurvey ...	539	9,663	1,16,890 (a)	12·1	(a) Excludes Rs. 4,729 cost of training pupils.
Cultivated plains, with some isolated hills.	**One-inch** Revision Survey ...	538				
City and Cantonments and Environs.	**Six-inch** Revision Survey ...	23				
No. 3 Party—*United Provinces.*						
High wooded hills.	**Half-inch** Revision Survey ...	2,419	2,419	62,996 (b)	26·0	(b) Excludes cost of settlement survey, experimental 4-inch survey under No. 23 Party and Khyber surveys.
TOTALS, NORTHERN CIRCLE:—		18,544 sq. m.		Rs. 2,69,528		Cost-rate 14·5

Table II.—OUT-TURNS of PLANE-TABLING and COSTS of Topographical Surveys, 1923-24.

Party and Locality. Character of Country.	Scale and Class of Survey.	Out-turns of Plane-tabling. Areas on each Scale of each Class.	Out-turns of Plane-tabling. Totals of areas on all Scales.	Costs of Survey including Mapping. Total Costs.	Costs of Survey including Mapping. Cost-rates.	Remarks.
		Sq. miles.		*Rs.*	*Rs. per sq. mile.*	
No. 5 Party—*Central India and Central Provinces.*						**SOUTHERN CIRCLE.**
Well cultivated plains and jungle-clad hills and plains.	**One-inch** Original Survey ...	2,994	5,495	1,09,016 (c)	19·8	(c) Excludes Rs. 253 debitable to the Commandant Royal Artillery, Southern Command.
	One-inch Revision Survey ...	1,206				
	Half-inch Original Survey ...	1,295				
No. 6 Party—*Madras and Hyderābād State.*						
Partly undulating cultivated country and partly densely wooded hills.	**Half-inch** Original Survey ...	7,767	8,777	1,58,573	18·1	
	One-inch Original Survey ...	1,010				
No. 7 Party—*Madras, Mysore and Hyderābād States.*						
Undulating, with patches of cultivation and numerous rocky outcrops and rocky hills covered with low scrub.	**One-inch** Original Survey ...	3,163	4,945	1,12,089	22·6	
	Half-inch Original Survey ...	1,152				
	One-inch Revision Survey ...	630				
No. 8 Party—*Bombay Presidency and Hyderābād State.*						
Portions of the Western Ghāts, the undulating plains, interspersed with outcrops of rocky low-lying hills, of the Deccan trap, and the open and cultivated plains of Hyderābād State.	**One-inch** Revision Survey ...	8,154	8,943	1,42,029 (d)	15·8	(d) Includes cost of fair-mapping and scattered auxiliary heights.
	One-inch Revision Survey ...	34				
	One-inch Original Survey ...	17				
	One-inch Original Survey ...	738				
TOTALS, SOUTHERN CIRCLE:—		**28,160 sq. m.**		**Rs. 5,21,707**	**Cost-rate 18·5**	

Table II.—OUT-TURNS of PLANE-TABLING and COSTS of Topographical Surveys, 1923-24.

Party and Locality. Character of Country.	Scale and Class of Survey.	Out-turns of Plane-tabling. Areas on each Scale of each Class. (Sq. miles)	Out-turns of Plane-tabling. Totals of areas on all Scales. (Sq. miles)	Costs of Survey including Mapping. Total Costs. (Rs.)	Costs of Survey including Mapping. Cost-rates. (Rs. per sq. mile.)	Remarks.
No. 4 Party—*Bengal, Bihār & Orissa.*—*(Rāniganj coalfields.)*						**EASTERN CIRCLE.**
Mostly open undulating ground, intersected by three large rivers, cultivated except in vicinity of the collieries with a few wooded areas and enclosed on the north, west and south sides by outcrops of low hills covered with scrub jungle.	**Four-inch** Supplementary Survey with 10-foot contours.	410	410	1,09,326 *(e)*	266·6	(e) Includes cost of transfer from Mussoorie to Hazāribāgh and of levelling, but excludes Rs. 1,846 cost of levelling in advance for future surveys.
No. 9 Party—*Bihār & Orissa.*						
Partly wooded hills, and partly cultivated open wooded undulating ground.	**One-inch** Original Survey ...	2,625	2,625	1,33,508	50·8	
No. 12 Party—*Assam and Burma.*						
Mostly high densely wooded hills and part of the open cultivated Manipur valley.	**Half-inch** Original Survey ...	7,442 *(f)*	8,328	2,18,193	31·2	(f) An area of 1,351 square miles of reconnaissance survey on the half-inch scale has been included in the out-turn but the area and cost (borne by the Assam Government) have not been used in calculating the cost-rates.
Mostly densely jungle-clad plains and low and high hills.	**One-inch** Original Survey ...	886				

TOTALS, EASTERN CIRCLE:— 11,363 sq. m. Rs. 4,61,027 Cost-rate 46·0

Table II.—OUT-TURNS of PLANE-TABLING and COSTS of Topographical Surveys, 1923-24.

Party and Locality. Character of Country.	Scale and Class of Survey.	Out-turns of Plane-tabling. Areas on each Scale of each Class. (Sq. miles.)	Out-turns of Plane-tabling. Totals of areas on all Scales. (Sq. miles.)	Costs of Survey including Mapping. Total Costs. (Rs.)	Costs of Survey including Mapping. Cost-rates. (Rs. per sq. mile.)	Remarks.
No. 10 Party—*Upper Burma and Lower Burma.*						**BURMA CIRCLE.**
Heavily wooded hills	Half-inch Original Survey	1,764				
High wooded hills	Half-inch Revision Survey	529				
Heavily wooded hills	One-inch Original Survey	866				
Wooded hills, open plains, creeks, islands and mangrove swamps.	One-inch Supplementary Survey.	1,200	4,389	1,99,756 (*g*)	45·5	(*g*) Includes Rs. 5,622 cost of forest surveys debitable to the Forest Department, Burma.
Wooded hills on island	Two-inch Original Survey	24				
Densely wooded hills	Four-inch Original Survey	6				
No. 11 Party—*Lower Burma.*						
High hills with dense evergreen forest, and well wooded low ground varied with hills, rock outcrops, and scattered cultivation.	One-inch Original Survey	1,306				
Cultivated areas, well wooded hills and plains and forest swamp.	One-inch Supplementary Survey.	999	2,451	1,86,798 (*h*)	76·2	(*h*) Includes Rs. 18,344 debitable to the Forest Department, Burma.
Low undulating ground densely wooded.	Two-inch Original Survey	130				
Hills and low ground densely wooded.	Four-inch Original Survey	16				
No. 18 Party (Aero-Photo)—*Lower Burma.*						
Densely wooded coastal portion of the Irrawaddy Delta.	Three-inch Original Air-Photo. Survey.	1,440	1,440	3,78,200 (*i*)	262·6	(*i*) Includes Rs. 3,03,000, debitable to the Forest Department, Burma.
No. 21 (Burma Forest) Party—*Lower and Upper Burma.*						
Densely wooded hills and plains	Four-inch Original Survey	4	776	1,79,502 (*j*)	231·3	(*j*) All debitable to the Forest Department, Burma.
	Two-inch Original Survey	772				
TOTALS, Burma Circle:—			**9,056 sq. m.**	**Rs. 9,44,256**	**Cost-rate 104·3**	
GRAND TOTALS:—			**67,123 sq. m.**	**Rs. 21,96,518**	**Cost-rate 33·4**	

NORTHERN CIRCLE (*vide* Index map No. 1).

DIRECTOR { Colonel E.A. Tandy, R.E., up to 18th March 1924.
{ Lieut.-Colonel L. C. Thuillier, I.A., from 19th March 1924.

12. No. 1 Party.—This party surveyed an area of 4,060 square miles partly on the one-inch and partly on the half-inch scale in the Allahābād, Bāndā, Jaunpur, Mirzāpur, Partābgarh, Rāe Bareli and Sultānpur districts of the United Provinces; 31 square miles on the scale of four inches to one mile in Allahābād and its immediate vicinity; 240 square miles on the one-inch scale in Bhadohi district of Benares State in the United Provinces; and 2,131 square miles partly on the one-inch and partly on the half-inch scale in the Indian States of Rewah (2,023 square miles) and Sohāwal (22 square miles) of the Baghelkhand Agency and Pannā (86 square miles) of the Bundelkhand Agency of Central India; or a total of 6,462 square miles. In addition, an area of 33 square miles was triangulated in the Allahābād district to supply data for the detail survey during the current season.

PERSONNEL.

Class I Officers.

Mr. C. C. Byrne, in charge to 5th October 1923.
Mr. M. C. Petters, in charge from 6th October 1923.

Class II Officers.

Major C. H. Tresham.
Mr. O. D. Jackson.
" Moqimuddin.

Upper Subordinate Service.

3 Officers.

Lower Subordinate Service.

33 Surveyors, etc.

The country surveyed on the one-inch scale consists mainly of well cultivated plains dotted over with numerous lakes, marshes and groves of mango trees and intersected by several rivers, the principal of which are the Ganges, Jumna and (southern) Tons. The area surveyed on the half-inch scale comprises portion of the plateau and the northern slopes of the Kaimur Hills. The plateau is covered with tall grass, but the northern slopes are densely wooded with a thorny undergrowth.

13. No. 2 Party.—This party surveyed an area of 590 square miles in the Hamīrpur and Bāndā districts of the United Provinces, 487 square miles in the Bijāwar, Charkhārī, Chhatarpur, Garrauli (Jāgīr), Lugāsi and Pannā States of the Bundelkhand Agency in Central India on the one-inch scale; and 4,057 square miles in Jaipur State, 586 square miles in Karauli State, 159 square miles in Tonk State, 429 square miles in Būndi State, and 2,089 square miles in Kotah State, all,

PERSONNEL.

Class I Officer.

Bt.-Lieut.-Colonel S. W. S. Hamilton, D.S.O., R.E., in charge to 31st December 1923, and again from 25th January 1924.

Class II Officers.

Mr. P. A. T. Kenny, O.B.E., in charge from 1st to 24th January 1924.
Mr. A. J. A. Drake.
" Duni Chand Puri.
" P. K. Ghosh, B.Sc., F.R.G.S.
" M. A. Chowdhury, B.A. (on probation).

Upper Subordinate Service.

6 Officers.

Lower Subordinate Service.

32 Surveyors, etc.

in Rājputāna, and 1,243 square miles in Gwalior State on the half-inch scale. The party also carried out revision survey of an area of 23 square miles for the map of Agra and Environs on the scale of six inches to one mile.

The country surveyed on the one-inch scale consisted of jungle-clad hills and cultivated plains, while that on the half-inch scale was very similar, with a large area of undulating forest country in addition.

An area of 9,400 square miles was triangulated in advance for next season's detail survey in Kotah and Gwalior States, in portions of the Bundelkhand Agency and in the Jhānsi district of the United Provinces.

14. No. 3 Party.—This party surveyed an area of 2,419 square miles on the half-inch scale in the Dehra Dūn and Garhwāl districts and Tehrī State of the United Provinces.

PERSONNEL.

Class I Officers.

Lieut.-Colonel L. C. Thuillier, I.A., in charge to 18th March 1924.
Mr. E. C. J. Hond., V.D., in charge from 19th March to 30th June 1924.
Major J. D. Campbell, D.S.O., R.E., in charge from 1st July 1924.

Class II Officers.

Mr. J. C. C. Lears.
,, J. H. Johnson.

Upper Subordinate Service.

5 Officers.

Lower Subordinate Service.

32 Surveyors, etc.

It comprised that portion of the Himālayas lying north of Mussoorie, east of Tehrī and around Rudraprayāg, Karnaprayāg and Chamoti, watered by the Bhāgīrathi, Alaknandā, Pindar and Mandākinī rivers. The hills rising from 4,000 to 19,000 feet above mean sea level are precipitous and generally densely wooded with oak and pine. The lower valleys are fairly well cultivated and communications are not difficult in the lower altitudes.

15. *Training.*—8 pupil surveyors were entertained during the year, and are receiving instruction in No. 20 Party.

In addition, a number of pupil surveyors were entertained in No. 3 Party and were trained in drawing during recess, with the view of employment on four-inch survey in the Sutlej Valley. 60 were eventually selected and posted to No. 20 Party for this work.

9 soldier surveyors joined for training during the year, and are receiving instruction in No. 2 Party.

16. *Recess Work.*—The fair-mapping of sheets of the previous and current season's survey, was completed by 30th September 1924, with the exception of four sheets on the one-inch, and five on the half-inch scale.

Five sheets, which have been drawn in colours as an experiment, have been delayed owing to the necessity of thickening up the red detail to ensure good reproduction.

The remainder have been delayed owing to the full drawing strength not being available for No. 3 Party, this party having had to make preparations for the Sutlej Valley four-inch work.

17. Particulars of work done by Nos. 22 and 23 Parties and Settlement Survey Detachment will be found on pages 62 to 64.

SOUTHERN CIRCLE (*vide* Index map No. 1).

DIRECTOR { Lt.-Col. G. A. Beazeley, D.S.O., R.E., up to 10th April 1924.
{ Lt.-Col. C. M. Browne, C.M.G., D.S.O., R.E., from 11th April 1924.

18. No. 5 Party.—This party surveyed an area of 5,495 square miles as follows:—18 square miles in Indore State, 117 square miles in Bhopāl State, both of the Central India Agency, and 4,065 square miles in the Hoshangābād, Betūl, Chhindwāra, Seoni, Bālāghāt and Bhandāra districts and Makrai State, all of the Central Provinces, on the one-inch scale; 45 square miles in Indore State and 1,250 square miles in Bhopāl State, both of the Central India Agency, on the half-inch scale.

PERSONNEL.
Class I Officer.
Major F. B. Scott, I.A., in charge.
Class II Officers.
Mr. J. H. S. Wilson.
" F. C. Pilcher.
" Muhammad Najamuddin, B.A.
Upper Subordinate Service.
1 Officer.
Lower Subordinate Service.
32 Surveyors, etc.

The country surveyed consists of well cultivated plains and jungle-clad hills and plains.

19. No. 6 Party.—This party completed an area of 7,767 square miles of original half-inch survey and 1,010 square miles of original one-inch survey in the Atrāf-i-balda, Karimnagar, Nalgonda and Warangal districts of Hyderābād and in the Kistna district of Madras.

PERSONNEL.
Class I Officer.
Major R. S. Wauchope, O.B.E., I.A., in charge.
Class II Officers.
Mr. E. A. Meyer.
" J. C. St. C. Pollett.
" A. F. Murphy.
" E. N. Natesan, B.A.
" C. P. E. Davenport (*on probation*).
Upper Subordinate Service.
6 Officers.
Lower Subordinate Service.
37 Surveyors, etc.

An area of 11,918 square miles of triangulation was completed in the Warangal and Karimnagar districts of Hyderābād, the Godāvari, Guntūr and Kistna districts and Agency Tracts of the Madras Presidency and in the Bastar State. This does not include about 400 square miles which was rapidly triangulated to fix stations in connection with some special work done for Messrs. Currimbhoy Ebrahim & Sons, Ltd.

240 linear miles of theodolite traversing were completed.

The country under survey varied from flat highly cultivated and populated areas to dense forest-clad hills.

20. No. 7 Party.—This party surveyed an area of 3,095 square miles in the Cuddapah and Anantapur districts of Madras and 698 square miles in the Kolār and Tumkūr districts of Mysore, on the one-inch scale; and 1,149 square miles in the Anantapur district of Madras and 3 square miles in the Tumkūr district of Mysore, on the half-inch scale. The party also triangulated an area of 4,582 square miles in the Anantapur, Bellary and Kurnool districts of Madras, and Raichūr district of Hyderābād.

PERSONNEL.

Class I Officer.

Major H. T. Morshead, D.S.O., R.E., in charge from 15th October 1923.

Class II Officers.

Mr. S. S. McA'Fee Fielding, in charge up to 14th October 1923.
Mr. V. W. Morton.
,, N. S. Harihara Iyer.

Upper Subordinate Service.

4 Officers.

Lower Subordinate Service.

26 Surveyors, etc.

The country surveyed was mostly flat or slightly undulating, with patches of cultivation and numerous low rocky outcrops, and presented no difficulties.

21. No. 8 Party.—This party surveyed an area of 8,943 square miles on the one-inch scale. Of this area, 772 square miles fell in Hyderābād State, and the balance of 8,171 square miles in the districts of East Khāndesh, West Khāndesh, Nāsik, Ahmadnagar, Thāna, Poona and Kolāba of the Bombay Presidency.

With the exception of the open and cultivated plains of Hyderābād State and the wooded heights of the Western Ghāts, the country surveyed consists of undulating plains interspersed with outcrops of rocky low-lying hills.

PERSONNEL.

Class I Officer.

Captain L. H. Jackson, I.A., in charge.

Class II Officers.

Mr. M. Mahadeva Mudaliar, M.A.
,, B. T. Wyatt.
,, M. S. Ganesa Aiyar.
,, Srinivasa Rao Kelkar, B.Sc. *(on probation).*

Upper Subordinate Service.

4 Officers.

Lower Subordinate Service.

44 Surveyors, etc.

22. *Instruction in Triangulation.*—A class was formed before the close of the recess season for instruction of officers and surveyors in triangulation and traversing.

1 Class II officer, 1 Upper Subordinate officer and 13 surveyors received instruction. The field work was carried out in the neighbourhood of Bangalore.

23. *Miscellaneous.*—Nos. 5, 6, 7 and 8 Parties, Circle Office and No. 4 Drawing Office were inspected by the Surveyor General in September 1924.

Nos. 5, 6, 7 and 8 Parties were inspected once in the field and on several occasions during recess by the Director, Southern Circle.

24. *Recess Work.*—45 one-inch sheets out of 64 surveyed and mapped during the year, 31 one-inch sheets previously surveyed and mapped, 6 one-inch sheets previously surveyed but with mapping incomplete and 1 one-inch sheet previously surveyed, mapped and submitted for publication (but of which the fair sheets were recalled before publication and revised during the year under report) were submitted by parties to the circle office before the 30th September 1924. All the remaining sheets will be fair-mapped before the close of the recess season. There are 2 one-inch sheets in arears; one, surveyed in 1921-22 but of which publication was withheld, has now been submitted to the circle office and one, surveyed during 1922-23 and fair-mapped last year, which was kept pending the settlement of a Madras-Mysore boundary question, will shortly be submitted by the party to the circle office.

3 original half-inch sheets out of 11 surveyed during the year were submitted by parties to the circle office before the 30th September 1924. The remaining 8 sheets will be fair-mapped before the close of the recess season. There are no arrears of mapping from the previous season's work.

Besides the above, 5 out of 8 two-inch special forest sheets of Hyderābād (Deccan) surveyed and mapped during the year and 1 similar sheet, the publication of which was withheld last year for completion of survey to margin, were submitted by No. 6 Party to the circle office before the 30th September 1924, and the remaining 3 sheets will be fair-mapped before the close of the recess season. 3 one-inch special forest sheets of Indore and Dhār States previously surveyed and mapped were submitted by No. 5 Party to the circle office before the 30th September 1924. There are no arrears of mapping of special forest sheets from the previous season's work with the exception of the 1 sheet of No. 6 Party mentioned above.

EASTERN CIRCLE (*vide* Index map No. 1).

DIRECTOR { Colonel W. M. Coldstream, C.I.E., R.E., up to 18th December 1923.
Lt.-Colonel A. A. McHarg, D.S.O., R.E., from 19th December 1923.

25. No. 4 Party.—This party was transferred from the Northern to the Eastern Circle on 1st October 1923 and surveyed an area of 410 square miles on the four-inch scale in the Rāniganj coalfield in the districts of Bānkurā, Birbhūm and Burdwān of Bengal and of Mānbhūm and Santāl Parganas of Bihār and Orissa.

PERSONNEL.

Class I Officer.
Mr. C. C. Byrne, in charge.
Class II Officers.
Major J. H. Williams.
Mr. J. H. Johnson.
Lieut. C. S. McInnes.
Upper Subordinate Service.
3 Officers.
Lower Subordinate Service.
28 Surveyors, etc.

The survey was mostly based on reductions of sixteen-inch cadastral survey supplemented by lines of levelling through the area, and contours at ten feet vertical intervals (as asked for by the Geological Department) have been shown. The sheets are being fair-mapped to comprise an area of five minutes of latitude by eight minutes of longitude.

The area surveyed consisted of open undulating country with the Dāmodar, its main tributary the Barākar and the Ajay rivers flowing through the area in the south-easterly direction.

The country is extremely well served by both railways and metalled roads, most collieries having their own branch lines as well as their private roads; in the immediate vicinity of collieries, the only cultivation lies, as a rule, in the course of the smaller streams, which are completely obliterated by terraced rice fields.

Water is scarce and is conserved in tanks for both irrigation and other purposes. In addition to the numerous collieries there are important iron works in the vicinity of Asansol, Rāniganj and Kulti, silicate works near Barākar junction, and potteries, oil presses, paper mills, &c., elsewhere.

26. No. 9 Party.—This party surveyed an area of 2,625 square miles as well as the Amdā-Jāmdā branch of the Bengal-Nāgpur Railway on the one-inch scale in the district of Singhbhūm and the Feudatory States of Bāmra, Bonai, Keonjhar, Mayūrbhanj and Pāl-Laharā in the province of Bihār and Orissa.

PERSONNEL.

Class I Officers.

Bt.-Lieut.-Colonel R. H. Phillimore, D.S.O., R.E., in charge to 31st October 1923.

Captain H. R. C. Meade, I.A., in charge from 1st November 1923.

Class II Officers.

Mr. E. J. Biggie.
" R. E. Saubolle.
" Bhupendra Nath Saha, M.Sc.

Upper Subordinate Service.

3 Officers.

Lower Subordinate Service.

32 Surveyors, etc.

The area under survey comprised cultivated open undulating country in the basins of the two large rivers, the Brāhmāni and Baitaraṇi, and sāl covered wooded hills rising to close on 4,000 feet.

An area of 540 square miles was triangulated for one-inch survey and 1,620 square miles were reconnoitred for triangulation during the ensuing field season in the districts of Singhbhūm and Angul and the Feudatory States of Bihār and Orissa.

27. No. 12 Party.—This party surveyed an area of 8,328 square miles on the one-inch and half-inch scales, in the Sadiyā Frontier Tract, the districts of Sibsāgar and Nāgā Hills and proposed controlled extension area adjoining the latter district in Tribal Area and the Manipur State in Assam as well as in the Upper Chindwin district of Burma.

PERSONNEL.

Class I Officers.

Lieut.-Colonel C. M. Browne, C.M.G., D.S.O., R.E., in charge to 2nd April 1924.

Bt.-Lieut.-Colonel R. H. Phillimore, D.S.O., R. E., in charge from 3rd April to July 1924.

Class II Officers.

Mr. B. M. Berrill, in charge from 26th July 1924.

Mr. E. M. Kenny.

„ D. K. Rennick, M.B.E.

„ R. C. Hanson.

Captain J. O'C. Fitzpatrick.

Mr. H. H. Creed.

Upper Subordinate Service.

5 Officers.

Lower Subordinate Service.

41 Surveyors, etc.

1,000 square miles of triangulation and 427 linear miles of traversing covering an area of 1,150 square miles were carried out in the Sadiyā Frontier Tract in advance of detail survey.

The area surveyed included part of the Brahmaputra valley, part of the Manipur valley and high hills ranging from 350 to 12,600 feet, the greater portion being covered with dense forest and in the Nāgā Hills comparatively scarcely inhabited.

28. *Training.*—Most of the pupils attached to parties in the field for training appear to be promising and will probably become useful surveyors.

Eight more pupils were entertained in April 1924; they were attached for training in field and recess work to No. 5 Drawing Office; two have now been posted to No. 9 Party and six to No. 4 Party for further training. Two of the eight appear to be very promising.

One Upper Subordinate officer of No. 4 Party, two of No. 12 Party and three surveyors of No. 9 Party received a little training in triangulation during recess.

29. *Recess Work.*—23 sheets were partly and 18 wholly surveyed by the three parties, of which 4 only have been received in the circle office.

No. 4 Party, owing to its new recess head-quarters being for reasons of economy at Hazāribāgh and away from circle head-quarters, to its new style of work and chiefly to the faulty arrangements made to obtain blue prints in time which resulted in a whole month's delay was unable to complete any of its sheets; all its sheets therefore have been transferred to No. 5 Drawing Office for completion which may be expected by the end of December 1924.

No. 9 Party's remaining 8 sheets will, it is expected, be submitted in November; this party started its field season too late and thereby curtailed its recess season, hence the incomplete submission of its sheets.

No. 12 Party has suffered from unavoidable changes in executive charges (five in eight months) and owing to its work lying in parts of 8 sheets, mostly with heavy contouring, all of which required completion to edge from old surveys, in addition to 13 other sheets, the total number of sheets to be drawn was rather larger than the party's drawing capacity; 2 sheets were submitted in October 1924, 7 more, examined by section officers but not by the Officer in charge, in November and the remaining 8 will probably be completed and submitted by end of December 1924.

A great deal of party work has therefore, mostly unavoidably, been handed over to the circle drawing office for completion. With the earlier start in field work this ensuing field season, however, there should be no excuse for a repetition of this next year.

BURMA CIRCLE (*vide* Index map No. 1).

DIRECTOR { Lt.-Col. C. P. Gunter, O.B.E., R.E., to 24th March 1924.
Lt.-Col. E. T. Rich, C.I.E., R.E., from 25th March to 4th August 1924.
Lt.-Col. R. H. Phillimore, D.S.O., R.E., from 5th August 1924.

30. No. 10 Party.—This party surveyed an area of 4,389 square miles on the half-inch, one-inch, two-inch and four-inch scales in the Akyab, Kyaukpyu and Sandoway districts of Lower Burma and in the Minbu and Thayetmyo districts of Upper Burma.

An area of 2,897 square miles was triangulated for topographical surveys in the same districts of Lower Burma.

PERSONNEL.

Class I Officers.

Captain O. Slater, M.C., R.E., in charge to 1st April 1924.
Captain G. Lemmox, I.A., in charge from 2nd April 1924.

Class II Officers.

Mr. S. S. McA'F. Fielding.
" F. J. Grice.
Captain F. E. R. Calvert.

Upper Subordinate Service.

4 Officers.

Lower Subordinate Service.

30 Surveyors, etc.

The nature of the country surveyed varies very considerably. Inland the area is hilly and well wooded and rises to 5,700 feet in the Arakan Yoma Range. The coast is highly cultivated and intersected by many tidal creeks. The hill ridges, which mainly run north and south, form in the sea area numerous wooded islands usually fringed with mangrove swamps. Nearly all communication in the coastal area is by water and in the hills by paths.

The party suffered considerably from depredations by tigers; one surveyor, one khalasi and one coolie were killed.

31. No. 11 Party.—Survey operations were continued in Lower Burma, in the Amherst district. The total area surveyed on all scales was 2,451 square miles, made up of 1,306 square miles original and 999 square miles supplementary surveys, on the one-inch scale; 130 square miles on the two-inch scale, and 16 square miles on the four-inch scale, of Reserved Forests. In addition an area of 2,605 square miles of supplementary and original triangulation was done, and 97 linear miles of traversing run, to supply data for current detail survey, and for next season's programme.

PERSONNEL.

Class I Officer.

Mr. J. O. Groiff, in charge.

Class II Officers.

Mr. P. Simpson.
,, G. E. R. Cooper.
,, A. V. Dickson.

Upper Subordinate Service.

3 Officers.

Lower Subordinate Service.

27 Surveyors, etc.

The country surveyed comprised part of the Dawna mountains, parts of the Thaungyin and Haungtharaw valleys, the northern portion of the Ataran valley, and the island of Bilugyun lying off the town of Moulmein, which was included in the area surveyed. Except for the fertile plains of Bilugyun island and those lying along the banks of the Ataran river, the country surveyed is hilly, furrowed by numerous streams and watercourses, and densely wooded, the mean elevation ranging between sea level and 5,000 feet, Mulayit, the highest peak on the Dawna range, being 6,822 feet high. The higher elevations are steep and precipitous and covered with dense evergreen forest, but in the low hills and spread out undulating valleys, the character of the jungle changes to a mixed forest of evergreen and deciduous trees and bamboo, with a heavy undergrowth of tall grass and scrub, and low lying forest swamps subject to annual floods. Part of the survey followed the Siamese frontier.

32. No. 18 Party (Aero-Photo).—From the 1st October 1923 the magnetic work and records of this party were taken over by the Director, Geodetic Branch, and, the party was reconstituted under its present designation in order to take up aerial survey of the Irrawaddy Delta forests.

PERSONNEL.

Class I Officers.

Major C. G. Lewis, R.E., in charge from 8th October 1923.
Mr. E. C. J. Bond, V.D., in charge to 7th October 1923.

Class II Officers.

Mr. L. Williams, M.B.E.
,, N. R. Mazumdar.

Upper Subordinate Service.

2 Officers.

Lower Subordinate Service.

1 Magnetic observer.
5 Computers, etc.

Approximately 1,440 square miles were surveyed by this method on the three-inch scale in the

Myaungmya and Pyapon districts of Lower Burma. The air-photography was carried out by Mr. R C. Kemp, in contract with the Government of Burma; the fixing of ground control points, the compilation of the mosaics and fair-mapping were carried out by this party. The survey was undertaken at the instance of the Forest Department which has borne 85 per cent. of the cost.

The type of country, consisting of densely wooded alluvial plains, intersected by tidal creeks, was particularly suited to survey from the air. (See also Section II, page 21).

33. No. 21 (Burma Forest) Party.—The work done by this party is included in that shown under Forest Surveys, Burma Circle, pages 20 to 22.

The area over which operations extended consists of densely wooded hills and plains.

PERSONNEL.

Class I Officer.

Mr. H. W. Biggie, in charge.

Class II Officers.

Lieut. L. B. Fitz-Gibbon.
Mr. T. F. Kitchen.
" H. M. Critchell.

Upper Subordinate Service.

3 Officers.

Lower Subordinate Service.

38 Surveyors, etc.

34. *Recess Work.*—The sheets to be drawn by the parties of the Burma Circle during the recess season numbered seventy including forty-eight special forest sheets. Besides these there were three one-inch and three special forest sheets in arrears from the previous year's drawing which have now been completed. None of the sheets surveyed during the year had been received in the circle office by the 30th September. They will probably all be sent for publication before the beginning of next recess season.

II.—FOREST SURVEYS.

35. Details of the topographical surveys of reserved forests executed by field parties of the Survey of India for the year are given below. In the majority of cases, the surveys were carried out on the one-inch scale, but in special cases the four-inch, two-inch and half-inch scales were used. An area of a little over one thousand square miles was surveyed by aerial photography and mapped on the three-inch scale. Boundary surveys were made where necessary, and plots will be prepared as required.

NORTHERN CIRCLE.

36. United Provinces. Western Forest Circle.—In the *Bāndā Forest Division*, a portion of the reserved forest areas for which four-inch sheets already exist, was revised on the half-inch scale in the course of the topographical surveys.

SOUTHERN CIRCLE.

37. Central Provinces. Southern Forest Circle.—In the *Bālāghāt Forest Division*, an area of 1·14 square miles was surveyed on the one-inch scale in the newly afforested extensions to the Chawarpani, Sonāwāni and Nawegaon reserved forests.

38. Madras. II and III Forest Circles.—In the *Anantapur, North Cuddapah and West Cuddapah Forest Divisions*, areas of 135·28 square miles and 172·74 square miles of reserved forests were surveyed on the one-inch and half-inch scales respectively.

EASTERN CIRCLE.

39. Assam. Eastern Forest Circle.—In the *Sadiyā Forest Division*, an area of 132 square miles was surveyed on the one-inch scale in the Sengajan and Depi Raya reserved forests.

BURMA CIRCLE.

40. Burma. Hlaing Forest Circle.—In the *Insein Forest Division*, 50 linear miles of boundaries of the Mahuya Reserve were

surveyed on the two-inch scale for adjustment with the old two-inch surveys of 1899-1902, which will be redrawn and published on the same scale with boundaries added.

Delta Forest Circle.—In the *Henzada-Ma-ubin Forest Division*, an area of 350·1 square miles was surveyed on the two-inch scale in the Padaw, Sinthe, Shwethanin, Kyangin, Yenandaung, Kaingtha, Myinwadaung and Extensions, South Myanaung and Extension and North Myanaung Reserves. In addition, an area of 98·4 square miles of unclassed forest land and cultivation was surveyed on the same scale to show the main approaches to these reserves, and 15 small exclusions scattered over the reserves were surveyed on the eight-inch and four-inch scales.

In the *Bassein Forest Division*, an area of 194 square miles in the Myittaya, Sinma and Sin-hmon Reserves was surveyed on the two-inch scale, and an area of 50·2 square miles of unclassed forest and cultivated land lying between the Sinma and Sin-hmon Reserves and the sea coast, was surveyed on the same scale. 13 small exclusions in the Sinma and Sin-hmon Reserves were also surveyed on the sixteen-inch and twenty-inch scales.

In the *Delta Forest Division*, the undermentioned reserved forest areas were surveyed by aerial photography:—

Name of Reserve.	Area in square miles.
Lebyauk	42
Kyagan Kwinbank	112
Kakayan	113
Pyinalan	165
Labutkwe	21
Kalayaik & Extension	37
Nyinaung	27
Kadonkani	234
Meinmahla	53
Pyindaye	302
Total ...	1,106

As photography was found unsuitable for the complete survey of the Lebyauk Reserve, which consists of low undulating hills, a considerable amount of supplementary work will be required on the ground.

The Pyindaye Reserve, surveyed by the Land Records Department in 1919-20 on the four-inch scale, was revised by air-photography.

Rectified mosaics of all the above reserves were compiled in Maymyo, and the fair-mapping on the three-inch scale, in twenty-eight sheets, is in hand.

In the *North Arakan Forest Division*, an area of 5·63 square miles of Block No. 1 of the Bandula Reserve was surveyed on the four-inch scale, and an area of 7·29 square miles of Blocks Nos. 2, 3, 4 and 5 of the same reserve was surveyed on the one-inch scale.

In the *South Arakan Forest Division*, an area of 23·5 square miles in the Kunchaung Reserve was surveyed on the two-inch scale.

Sittang Forest Circle.—In the *South Pegu Forest Division*, an area of 4 square miles was surveyed on the four-inch scale in the Pyinbongyi Extension, now one of the component blocks of the Salu Reserve, and an area of 2 square miles of the Shanywagyi Block of the same reserve was surveyed on the two-inch scale. In addition 92·8 linear miles of the boundaries of the Aungmya, Kalein and Talaingma Reserves, and the Aseilttaung and Shanywagyi Blocks of the Salu Reserve were surveyed on the two-inch scale for adjustment with the old two-inch surveys of 1899—1902, which will be redrawn and published on the same scale with boundaries added.

Tenasserim Forest Circle.—In the *Thaungyin Forest Division*, an area of 5·70 square miles of the Mekane, Kyaukket and Mepele-Thaungyin Extensions was surveyed on the four-inch scale, and 30·5 linear miles of the boundaries of the Taok and Ta-u-ke Reserves were surveyed on the same scale. In addition 45 linear miles of new roads in the Mepele-Thaungyin, Mekane and Kyaukket Reserves were surveyed on the four-inch scale in the course of one-inch topographical operations for incorporation in the old four-inch forest sheets.

In the *Ataran Forest Division*, an area of 9·77 square miles comprising Gwingyi Extension III, and part of Megwa Extension II was surveyed on the four-inch scale, and an area of 130·15 square miles of the Dali Reserve was surveyed on the two-inch scale.

Northern Forest Circle.—In the *Kathā Forest Division*, an area of 75·5 square miles, including 2·5 square miles of unclassed forest land, was surveyed on the two-inch scale in the Mezabya Reserve.

Chindwin Forest Circle.—In the *Minbu Forest Division*, an area of 115·14 square miles comprising portion of Mon Reserve and Mon Extension I, was surveyed on the half-inch scale.

III.—CANTONMENT AND LARGE SCALE SURVEYS.

41. No. 20 Party.—During the year the party completed the survey of Chaklālā, Pathānkot and Kohāt cantonments on the 16-inch scale, and Mona and Sargoda on the 6-inch scale. The bāzār area of Kohāt cantonment was also surveyed on the 64-inch scale.

PERSONNEL.
Class I Officer.
Mr. C. E. C. French, in charge.
Upper Subordinate Service.
1 Officer.
Lower Subordinate Service.
21 Surveyors, etc.

The survey of Montgomery was abandoned by order of the General Officer Commanding, Ferozepore, as it ceased to exist as a cantonment on the 1st October 1924.

200·58 linear miles of traversing and 60·93 linear miles of levelling were completed at a cost of Rs. 31·66 and Rs. 19·11 per linear mile respectively.

The fair-drawings of Madras Military Lands, Wellington, Ahmadābād and the bāzārs of Deolāli and Ahmadābād have been completed and submitted for publication.

The out-turn and cost-rates of the various surveys are as follows:—

Sixteen-inch original, 3,734·00 acres @ Rs. 1·32 per acre.

Sixteen-inch revision, 2,336·00 acres @ Rs. 1·82 per acre.

Sixty-four-inch revision, 6·04 acres @ Rs. 47·67 per acre.

Six-inch original 35·00 square miles @ Rs. 213·84 per square mile.

The total areas fair-mapped with cost-rates are as follows:—

11,844·00 acres on the sixteen-inch scale @ Re. 0·99 per acre.

3,635·00 acres on the twelve-inch scale @ Re. 0·51 per acre.

140·00 acres on the sixty-four-inch scale @ Rs. 18·93 per acre.

66·00 acres on the forty-eight-inch scale @ Rs. 13·95 per acre.

Alphabetical List of Cantonments and Military Stations surveyed and published up to the end of 1923-24.

(1) Agar Cantonment.
(2) Aurangābād do.
(3) Ahmadnagar do.
(4) Ahmadābād do.
(5) Bakloh do.
(6) Balūn or Thath (Dalhousie) Camp Area.
(7) Bannu Cantonment.
(8) Bellary do.
(9) Bangalore Civil & Military Station.
(10) Chaman Cantonment.
(11) Chitrāl Station.
(12) Cannanore Cantonment.
(13) Dehra Dūn do.
(14) Deoli do.
(15) Drazinda Out Post.
(16) Drosh Cantonment.
(17) Delhi New do.
(18) Deolāli & neighbourhood (6-inch).
(19) Erinpura Cantonment.
(20) Fort Lockhart.
(21) Ghairat Station.
(22) Guna Cantonment.
(23) Hangu do.
(24) Hāpur (Bābūgarh) Remount Depôt.
(25) Hosūr Remount Depôt.
(26) Jandola Out Post.
(27) Jatta do.
(28) Jhelum Cantonment.
(29) Jullundur do.
(30) Jhānsi do.
(31) Kālka Cantonment.
(32) Kamptee do.
(33) Karāchi Port Trust (Manora).
(34) Landour Cantonment.
(35) Meerut do.
(36) Madras District Military Lands.
(37) Nasīrābād Cantonment.
(38) Nīmach do.
(39) Peshāwar do.
(40) Pallāvaram do.
(41) Poonamallee do.
(42) Quetta do.
(43) Quetta Fort.
(44) Quetta Civil Station.
(45) Rājkot Cantonment.
(46) Rāwalpindi do.
(47) Sahāranpur Remount Depôt.
(48) Sanāwar Cantonment.
(49) Saugor do.
(50) Siālkot do.
(51) Simla Indian Infantry Lines.
(52) Sitābaldī Fort (Nāgpur).
(53) Saint Thomas's Mount Cantt.
(54) Secunderābād & Bolārum Cantt.
(55) Thal Cantonment.
(56) Topa do.
(57) Velichi Military Lands.
(58) West Hill Cantonment.
(59) Wellington do.
(60) Zām Out Post.

IV.—GEODETIC BRANCH.

DIRECTOR { Lt.-Colonel H. McC. Cowie, R.E., up to 30th March 1924.
Dr. J. deGraaff Hunter, M.A., Sc.D., F. Inst.P., from 31st March to 27th April 1924.
Lt.-Colonel R. H. Thomas, D.S.O., R.E., from 28th April 1924.

GEODETIC OPERATIONS.

42. No. 13 Party.—Astronomical Latitudes.—This party was employed on latitude operations, the old Zenith telescope No. 1 by Messrs. Troughton and Simms on its wooden stand being used throughout for the observations. Latitudes were observed at 4 stations in Bihār and Orissa and 9 in the United Provinces. The stations in Bihār and Orissa lay along the B. & N. W. Railway to the north-east and south-east of Gorakhpur. Those in the United Provinces lay along the B. & N. W. Railway and O. & R. Railway north of Gorakhpur and along the line Gorakhpur-Benares-Partābgarh-Ajodhyā (Lakarmandi Ghāt).

PERSONNEL.
Class I Officer.
Major C. M. Thompson, I.A., in charge.
Lower Subordinate Service.
3 Computers, etc.

The results of the observations are given in the following table:—

Station.	Height Feet.	Longitude.	Geodetic Latitude. G	Astronomical Latitude. A	A—G
		° ′ ″	° ′ ″	′ ″ ″	
Shāhpur ...	173	85 47 25·37	26 24 42·37	24 42·73 ± ·067	+ 0·36
Sinaria ...	239	85 15 54·25	26 45 12·55	45 6·27 ± ·082	− 6·28
Sikta ...	267	84 40 54·56	27 1 44·04	1 31·97 ± ·098	−12·07
Rāmnagar ...	312	84 19 35·56	27 9 4·09	8 50·43 ± ·102	−13·66
Mathia ...	334	83 51 32·13	27 8 4·37	7 54·10 ± ·083	−10·27
Rajabari ...	267	83 15 35·49	26 54 3·04	54 2·12 ± ·067	− 0·92
Saunharsa ...	315	83 21 18·45	27 11 26·33	11 16·36 ± ·086	− 9·97
Baniapar ...	267	83 23 2·28	26 15 7·72	15 15·50 ± ·076	+ 7·78
Kamaun ...	270	83 23 51·38	25 43 3·62	43 13·38 ± ·055	+ 9·76
Ramapura ...	350	82 5 40·58	25 44 55·09	45 3·23 ± ·069	+ 8·14
Sirwara ...	348	82 7 30·01	26 16 23·86	16 33·74 ± ·055	+ 9·88
Bisaul ...	342	82 20 54·43	26 40 37·38	40 42·76 ± ·069	+ 5·38
Kopa ...	365	82 12 48·22	27 7 3·74	7 1·24 ± ·053	− 2·50

A positive value of A—G denotes a southerly attraction of the plumb-line.

The topographical effects attributable to visible masses have been estimated from maps and the Hayford deflections deduced therefrom on the hypothesis of a uniform isostatic compensation at a depth of 113·7 kilometres. The following table shows the residuals for the above stations unexplained by the Hayford hypothesis :—

Station.	Observed Astro. Deflection.	Estimated Topo. Deflection.	Hayford Deflection.	Unexplained Residual or Observed—Hayford Deflection.
	"	"	"	"
Rāmnagar ...	—13·66	—86·36	— 7·18	— 6·48
Saunbarsa ...	— 9·97	—77·02	— 4·37	— 5·60
Sikta ...	—12·07	—85·91	— 6.59	— 5·48
Mathia ...	—10·27	—81·39	— 5·27	— 5·00
Sinaria ...	— 6·28	—83·20	— 5·57	— 0·71
Kopa ...	— 2·50	—66·29	— 2·59	+ 0·09
Rajabari ...	— 0·92	—70·19	— 3·05	+ 2·13
Shāhpur ...	+ 0·36	—77·64	— 3·94	+ 4·30
Bisaul ...	+ 5·88	—58·82	— 1·38	+ 6·76
Ramapura ...	+ 8·14	—47·18	— 0·32	+ 8·46
Baniapar ...	+ 7·78	—57·92	— 1·12	+ 8·90
Kanaun ...	+ 9·76	—51·58	— 0·17	+ 9·93
Sirwara ...	+ 9·88	—51·73	— 0·77	+10·65

It will be seen from the above table that on the Gangetic plain, on which the observations were taken this season, the Hayford residuals increase nearly steadily from north to south, *viz*:–from −6·48 to +10·65. The Hayford theory, though reducing the large negative estimated topographical deflections to smaller negative values, does not account for the actual negative values obtained in the northern portion (about one-quarter), nor explain the positive values which appear in the southern portion (about three-quarters) of the Gangetic plain.

An examination of the change of deflections points to the fact that as we proceed from the north to the south of the Gangetic plain, the

latitude stations come more vertically above the "hidden chain" or sub-surface excess of density, referred to in Professional Paper 5, which falls in the neighbourhood of latitude 22° in this area.

The Himālayan attraction would appear to emanate from a greater depth and material of lesser density, and the attraction of the "hidden chain" would appear to emanate from a lesser depth and denser material than can be accounted for on the Hayford hypothesis.

43. No. 14 Party.—Pendulum Observations.—This party made pendulum observations at 11 stations extending from Pīlībhīt (U. P.) to Motihāri (Bihār). The table annexed gives the results of the observations. These observations complete the examination of the Gangetic plain between the meridians of 78° and 85° and show that the two small belts of high density predicted from 1912-13 results are non-existent. There appears to be a simple trough of low density, deepest at the foot of the Himālayas and rising gradually right across the plain to the "hidden chain" without any intervening belts of higher density.

PERSONNEL.

Class I Officers.

Major W. E. Perry, M.C., R.E., in charge up to 14th October 1923.

Major H. J. Couchman, D.S.O., M.C., R.E., in charge from 15th to 22nd October 1923.

Captain E. A. Glennie, D.S.O., R.E., in charge from 23rd October 1923.

Class II Officers.

Mr. Raj Bahadur Mathur, B.A.

Lower Subordinate Service.

3 Computers, &c.

Summary of results of Pendulum observations.

Station.	Latitude. N.	Longitude. E.	Height above M. S. L.	Corrections. For Height.	Corrections. Bouguer.	Corrections. Hayford.	γ_0	γ_A (Free Air).	γ_B (Bouguer).	γ_C (Hayford).	g	$g-\gamma_A$	$g-\gamma_B$	$g-\gamma_C$
	° ′ ″	° ′ ″	*Feet.*	*dynes.*	*dynes.*	*dynes.*	*dynes.*	*dynes.*	*dynes.*	*dynes.*	*dynes.*	*dynes.*	*dynes.*	*dynes.*
Etáwah ...	26 47 00	79 00 55	492	— 046	+ 017	— 003	979·079	979·033	979·050	979·011	978·998	—0·035	—0·052	—0·013
Fatehgarh ...	27 22 06	79 38 00	493	— 046	+ 017	— 004	979·121	979·075	979·092	979·052	979·023	—0·052	—0·069	—0·029
Pilibhít ...	28 39 05	79 49 31	610	— 057	+ 021	— 019	979 216	979·159	979·180	979·100	979·045	—0·114	—0·135	—0·055
Shahjahánpur ...	27 54 21	79 55 52	510	— 048	+ 017	— 007	979·161	979·113	979·130	979·079	979·040	—0·073	—0·090	—0·039
Sítapur ...	27 33 13	80 41 08	449	— 042	+ 015	— 008	979·135	979·093	979·108	979·057	979·003	—0·090	—0·105	—0·054
Sonáripur ...	28 27 39	80 44 24	514	— 048	+ 017	— 031	979·203	979·155	979·172	979·080	979·013	—0·142	—0·159	—0·067
Bahraich ...	27 34 02	81 35 41	403	— 038	+ 014	— 015	979·136	979·098	979·112	979·039	978·977	—0·121	—0·135	—0·062
Gonda ...	27 08 21	81 56 25	352	— 033	+ 012	— 010	979·105	979·072	979·084	979·034	978·949	—0·123	—0·135	—0·085
Gainsari ...	27 31 43	82 35 45	364	— 034	+ 012	— 028	979·133	979·099	979·111	979·034	978·943	—0·156	—0·168	—0·091
Bagaha Ghát ...	27 08 06	84 03 05	298	— 028	+ 010	— 024	979·104	979·076	979·086	979·011	978·923	—0·153	—0·163	—0·088
Motihári ...	26 39 10	84 54 35	220	— 021	+ 007	— 018	979·069	979·048	979·055	978·994	978·895	—0·153	—0·160	—0·099

PERSONNEL.

Class I Officers.

Major C. M. Thompson, I.A., in charge up to 7th October 1923.
Mr. Hanuman Prasad, Rai Sahib, in charge from 8th October 1923 to 16th July 1924.
Major W. E. Perry, M.C., R.E., in charge from 17th July to 14th August 1924.
Captain O. Slater, M.C., R.E., in charge from 15th August 1924.

Class II Officer.

Mr. G. J. S. Rae.

Lower Subordinate Service.

3 Computers, etc.

44. No 15 Party.—Triangulation.—No field operations were carried out by this party during the year under report, the personnel being employed at the Head Quarter Offices of the Geodetic Branch, Survey of India.

PERSONNEL.

Class I Officer.

Dr. J. deGraaff Hunter, M.A., Sc.D., F. Inst. P., in charge.

Class II Officer.

Mr. D. H. Lunn.

Lower Subordinate Service.

10 Computers, etc.

45. No. 16 Party.—Tidal Operations.—Tidal registrations were carried out by means of self registering tide-gauges during the year under report at the following stations :—

Stations.	Date of commencement of observations.	Date of closing of observations.	Number of years of observations.	Remarks.
Aden ...	1879 ...	Still working	45	
Karāchi ...	1868 ...	1880	*13 } 56	*With a small tide-gauge.
	1881 ...	Still working	43	
Bombay (Apollo Bandar).	1878 ...	„	46	
Bombay (Prince's Dock).	1888 ...	„	36	Observations are being continued solely for the purposes of the Port Trust.
Madras ...	1880 ...	1890	10 } 39	
	Restarted 1895	Still working	29	
Kidderpore ...	1881 ...	„	43	
Rangoon ...	1880 ...	„	44	
Moulmein ...	1880 ...	1886	6 } 21	
	Restarted 1909	Still working	15	
Bassein (Burma) ...	1902 ...	1905	2 } 3	
	Restarted 1923	Still working	1	Obsrvations were restarted on 28th November 1923.
Port Blair ...	1880 ...	„	44	
Basrah ...	1916 ...	1922	§7 } 9	§Observations taken on a tide-pole.
	1922 ...	Still working	†2	†Registrations taken on an automatic tide recorder.

In addition to the above, the readings of the actual times and heights of high and low-water at Bhaunagar, Chittagong and Akyab were continued under the orders of the Port Officers concerned, who forwarded these results monthly to this office.

Since the 2nd November 1923, the Port Director, Basrah has been forwarding the weekly charts of the tidal curves that are being registered on the automatic tide recorder at Margil, and this is still being continued.

The observations for the year commencing 1st January 1923 were reduced by the method of harmonic analysis and the constants thus deduced were used in the computation of data for the Basrah tide-tables for 1925.

The tide predictions for the 1925 tide-tables for Basrah as also for the Indian ports, were carried out with the aid of the tide-predicting machine at Dehra Dūn. The printing and publication of these tide-tables were carried out in the office of the Director of the Geodetic Branch, Survey of India, Dehra Dūn, and the despatch of the same is expected to be completed by about the end of October 1924. Advance copies, in manuscript form, of the tide-tables for 1925 of the following ports:—Suez, Aden, Būshire, Karāchi, Bombay, Madras, Chittagong, Mergui, Dublāt (Sāgar Island), Diamond Harbour, Kidderpore, Elephant Point, Bhaunagar, Colombo, Rangoon, Marmagao and Trincomalee were prepared and despatched to the Hydrographer to the Admiralty by the end of May 1924. Similarly, for the Hooghly river, to the Deputy Conservator of the Port of Calcutta and to Messrs. Thomas Cook & Son in addition. Advance copies in manuscript form of the tidal predictions for the Hooghly river for the months of February, March and April 1926 were prepared and despatched to the Port Officer, Calcutta.

Tidal registrations at the ten observatories still working have been carried out satisfactorily, and will be continued during the coming year. During the past year the following observatories were inspected:—Port Blair, Rangoon and Kidderpore. In addition, a new tide-gauge was installed at Bassein and tidal registrations were restarted at this station after the lapse of 21 years, and will be continued till satisfactory data is obtained on which the future predictions for Bassein can be based, and which, it is hoped, will enable more accurate predictions being made.

The following table shows the annual and decadal percentages of errors in the predicted times and heights of high and low-water at the eight stations where observations have been taken on self registering tide-gauges, from which it will be seen that the predictions for 1923 were as accurate as those carried out in the past under the direction of the National Physical Laboratory, Teddington.

PERCENTAGE OF ERRORS IN PREDICTED TIMES AND HEIGHTS.

Year.	AT OPEN COAST STATIONS.						AT RIVERAIN STATIONS.					
	Number of Stations.	IN TIME.		IN HEIGHT.			Number of Stations.	IN TIME.		IN HEIGHT.		
		Within 15 minutes of actuals.		Within 8 inches of actuals.		Within $\frac{1}{10}$ of mean range at springs.		Within 15 minutes of actuals.		Within 8 inches of actuals.		Within $\frac{1}{10}$ of mean range at springs.
		H.W.—L.W.		H.W.—L.W.		H.W.—L.W.		H.W.—L.W.		H.W.—L.W.		H.W.—L.W.
1914	6	77	79	96	97	98	98	3	75	67	71	55	92	84
1915	6	82	82	98	98	96	96	3	76	66	73	67	94	92
1916	6	81	82	96	97	96	99	3	81	68	73	62	93	87
1917	6	75	72	96	98	96	97	3	78	65	69	64	92	88
1918	6	83	82	97	97	97	96	3	76	63	66	65	90	89
1919	6	78	75	96	97	97	98	3	74	65	70	69	93	92
1920	6	82	81	94	97	97	98	3	76	66	64	62	89	86
1921	6	77	72	94	97	97	99	3	74	66	75	71	92	94
1922	5	81	75	97	98	96	97	3	73	66	71	73	92	95
1923	5	73	71	98	96	96	95	4	52	49	63	61	75	78
Average of ten years.	...	79	77	96	97	97	97	...	74	64	70	65	90	89

Tide-predicting machine.—The height curves and time charts for the 1925 tide-tables were completed on the machine by about the end of January 1924. The height curves and time charts for the 1926 tide-tables are in hand at present and will, it is hoped, be completed before the end of October 1924.

Electrical registration of height of water at any time in tidal prediction.—A device was introduced by Dr. deGraaff Hunter, which was fitted to the tide-predicting machine designed by Lord Kelvin and Mr. Edward Roberts, which is now employed by the Survey of India at Dehra Dūn, to record electrically on a chronograph the times at which successive prescribed heights of water are reached. The device may be found useful on other machines where vertical motion is recorded against time or other abscissæ.

A full explanation and an illustration of this device is contained in the Journal of Scientific Instruments, Vol. I, No. 8, May 1924. Copies of the chart, recording the heights and times of high and low-water at Bombay for 1925 can be obtained from the Secretary, the Institute of Physics, 10, Essex Street, W. C. 2.

The tidal predictions for 1926 for the 40 Indian ports are being run off on the tide-predicting machine, using the above device.

46. No. 17 Party.—Levelling.—Five detachments, three single, one double, one special, and a tertiary levelling group were employed in the operations summarised below:—

PERSONNEL.
Class I Officer.
Major A. H. Gwyn, I.A., in charge.
Class II Officers.
Mr. R. N. Mazumdar.
„ O. N. Pushong.
„ Jiya Lal Sahgal.
Upper Subordinate Service.
7 Officers.
Lower Subordinate Service.
27 Computers, &c.
64 purely temporary Levellers.

(*a*) *In the Punjab*, from Jhang to Multān and from Bahāwalpur to Khānpur.

(*b*) *In Bombay*, from Nakhtrāna Motā to Viramgām, *via* Rājkot.

(*c*) *In Rājputāna*, from Mārwār Pāli to Govardhanlā, *via* Barmer and Jaisalmer.

These three lines form part of the new level net of India.

(*d*) *In Burma*, for the Public Works Department (Irrigation).—

(1) from Kyaukse to Minzu
(2) „ Ywakainggyi to Amarapura
(3) „ Yewe to Meiktila
(4) „ Kyaukse to Mandalay
(5) „ Kyauktaga to Myitkyo
(6) „ Dalanun to Pazunmyaung
(7) „ Moulmein to Pa-an
(8) „ Moulmein to Wēkali
(9) „ Babukon to Kawmyatkyi
(10) „ Nyaungbinzeik to Natchaung.

(*e*) *In Bombay*, (special detachment), gravity survey near Khairpur Mirs.

(*f*) *In the Punjab*, for the Sutlej Valley Irrigation project, an extension of the "tertiary" levelling net work in the Multān, Montgomery and Lahore districts, and in the Bahāwalpur State.

The party completed 990 miles of primary, 659 miles of secondary and 31,865 miles of tertiary levelling; the greater part of the work being done for Local Governments (*vide* para. 71).

47. No. 19 Party.—Base Line Operations.—No comparator or base line work was undertaken by this party during the year under report, the personnel being employed at the Head Quarter Offices of the Geodetic Branch, Survey of India.

PERSONNEL.
Class I Officers.
Captain H. E. Roome, M.C., R.E., in charge to 21st October 1923.
Lt.-Colonel H. McC. Cowie, R.E., in charge from 22nd October 1923 to 31st March 1924.
Dr. J. deGraaff Hunter, Sc. D., M.A., F. Inst. P., in charge from 1st to 11th April 1924.
Captain O. Slater, M.C., R.E., in charge from 12th April 1924.
Lower Subordinate Service.
1 Magnetic Observer.
1 Surveyor.

PART 3.—OFFICE WORK.

I.—HEAD QUARTER OFFICES.

MAP PUBLICATION OFFICE (*vide* Index maps at end).

DIRECTOR

Lt.-Col. A. A. McHarg, D.S.O., R.E., up to 18th December 1923.
Lt.-Col. M.O'C. Tandy, D.S.O., O.B.E., R.E., from 19th December 1923 to 25th February 1924.
Lt.-Col. F. F. Hunter, D.S.O., I.A., from 26th February to 30th March 1924.
Col. H. Wood, R.E., from 31st March 1924.

PERSONNEL.

Class II Officer.

Mr. Pramadaranjan Ray, B.S.

48. Brief reports of the work carried out during the year under review in the six offices administered by the Map Publication Office are given in paras. 50 to 54, 64, 73 and 74.

49. The classes of maps for the publication of which the Head Quarter Offices are responsible are as follows:—

(*a*) Topographical maps on the one-inch scale.

(*b*) Topographical maps on the half-inch scale.

(*c*) Topographical maps on the quarter-inch scale.

(*d*) (*i*) Geographical maps on the 1:1,000,000 scale (about 1 inch = 16 miles).

(*ii*) La Carte Internationale du Monde on the 1:1,000,000 (about 1 inch = 16 miles).

(*e*) Geographical maps on the 1:2,000,000 scale (about 1 inch = 32 miles).

(*f*) General maps on the same and smaller scales.

(*g*) Special maps.

The progress made in the publication of each of these classes is detailed below:—

(*a*) **Topographical maps on the one-inch scale.**— During the year 187 modern sheets have been published. The General Staff have now decided to treat this series as the tactical map of India, in place of the half-inch series.

Index map No. 2 at the end of this report shows the progress made in the publication of the modern one-inch public sheets, and the following table gives the output of these sheets since the modern topographical surveys were begun :—

Years of publication.	Number of one-inch sheets published.				
	Northern Circle.	Southern Circle.	Eastern Circle.	Burma Circle.	Totals
1906-15	518	314	358	Figures for 1906-23 are included in the Eastern Circle.	1,190
1915-16	85	69	50		204
1916-17	23	40	22		85
1917-18	18	12	13		43
1918-19	32	19	6		57
1919-20	15	37	52		104
1920-21	15	11	19		45
1921-22	20	46	29		95
1922-23	32	38	18		88
1923-24	**62***	**71**	**39**	**15**	**187**
Total published ...	820	657	†284	§337	2,098
Probable number of one-inch sheets which will not be published owing to the area covered by them being included in the programme for survey and publication on the half-inch scale ...	911	564	278	195	1,948
Approximate number remaining for publication ...	421	808	420	523	2,172
Approximate number of public one-inch sheets in India	2,152	2,029	982	1,055	6,218

* In addition 3 one-inch sheets have been published on the 2-inch scale.
† Excluding 322 sheets of the Burma Circle.
§ Including 322 sheets published in 1906—23.

In addition to the above, preliminary editions (in colours) of 20 one-inch sheets, prepared from modern revenue surveys, have been published during the year pending their topographical revision. One provisional issue of a one-inch sheet has also been published during the year.

27 modern one-inch, 11 preliminary editions, 1 provisional issue of one-inch, and 60 old style one-inch sheets have been reprinted during the year.

(*b*) **Topographical maps on the half-inch scale.**—Index map No. 3 at the end of this report shows the progress made in the publication of the modern half-inch public sheets. This series, which was commenced in 1914, is no longer treated as the *tactical* map of India. Most of the sheets published up to date are reductions from the one-inch map, but others are from direct half-inch surveys.

The following table gives the output of these sheets:—

Years of publication.	Number of half-inch sheets published.		
	Drawn from component one-inch sheets.	Surveyed on half-inch scale.	Total.
1914-15	...	1	1
1915-16	21	4	25
1916-17	50	6	56
1917-18	59	6	65
1918-19	26	4	30
1919-20	31	8	39
1920-21	59	2	61
1921-22	75	7	82
1922-23	52	4	56
1923-24	**68**	**24**	**92**
Totals	441	66	507
Approximate total number of half-inch sheets in India	.....	.....	1,630

12 modern public half-inch sheets have been reprinted during the year.

(*c*) **Topographical maps on the quarter-inch scale.**—These maps are prepared in "degree" sheets which include 1° of latitude and 1° of longitude, *i.e.*, the area covered by 16 one-inch sheets, or 4 half-inch sheets.

Index map No. 4 at the end of this report shows the progress made in the publication of the modern quarter-inch public sheets.

The following table gives the output of these sheets:—

Years of publication.	Number of "Degree" sheets published.				
	Northern Circle.	Southern Circle.	Eastern Circle.	Burma Circle.	Total.
1911-15	10	8	10	Figures for 1911-23 are included in the Eastern Circle.	28
1915-16	...	1	4		5
1916-17	1	...	3		4
1917-18	...	...	4		4
1918-19	...	3	8		11
1919-20	4	...	4		8
1920-21	1	...	...		1
1921-22	1	3	6		10
1922-23	10	8	2		20
1923-24	**13**	**8**	**4**	**3**	**28**
Totals	40	31	25*	23†	119
Approximate number of "degree" sheets in India ...	170	140	75	65	450

* Excludes 20 sheets of the Burma Circle.
† Includes 20 sheets published in 1911—23.

8 preliminary sheets in colours from comparatively modern surveys have been published and 20 modern and 2 preliminary sheets are at press.

In addition to the above, 4 modern, 3 preliminary and 17 provisional public quarter-inch sheets have been reprinted during the year.

(*d*) **Geographical Maps on the 1:1,000,000 scale.**—(*i*) **The 'India and Adjacent Countries" Series** (*Vide* Index map No. 5).—During the year no new sheet of this series has been published, but 9 sheets have been reprinted.

(*ii*) **La Carte Internationale du Monde.**—(*Vide* Index map No. 6).—A full description of the genesis of this series was given in the General Report for 1913-14. During the year one new sheet has been published making a total of 13 sheets up to date, and one sheet has been reprinted.

(*e*) **Geographical Maps on the 1:2,000,000 scale.**—(*Vide* Index map No. 7).—2 new sheets have been published during the year and 1 map has been reprinted.

(*f*) **General Maps on the same and smaller scales.**—The engraved plates of all these maps have been corrected and brought up to date as far as possible and 2 maps have been reprinted during the year.

(*g*) **Special maps.**—The annual edition of the Railway Administration map (on the scale of 1 inch = 64 miles) has been corrected and will be published in November 1924.

One new provincial map (on the scale of 1 inch = 32 miles) has been published and two have been reprinted.

Maps of 'Calcutta and Surrounding Country' (scale one inch = one mile), 'Secunderābād and Bolārum' (scale three inches = one mile) and 'Benares and Environs' (scale four inches = one mile) have been published and the Town Guide map of Lucknow (scale twelve inches = one mile) in 2 sheets has been reprinted.

Plan of City of Calcutta on scale three inches = one mile has also been reprinted.

Numerous special maps have also been prepared and printed for the Army, for Local Governments, Railways and other Departments. The work for the Army has been particularly heavy owing to the introduction of a new system of map references, according to which all topographical maps supplied to the military have to be surprinted with a mesh showing one-minute squares.

50. Map Record and Issue Office.—During the year sales to the public again showed a steady increase over previous years.

The Catalogue was reprinted after being brought up to date 1st July 1924.

The re-organization of the record room continued. Up to date 5,206 steel and asbestos, or entirely steel shelves have been completed. The racks are connected by expanded steel galleries. The whole installation is fire proof and lighted by electricity.

980,132 maps, plans and diagrams valued at Rs. 4,47,710 were issued during the year as compared with 359,917 valued at Rs. 2,11,014 issued in 1913-14.

The Branch Office formerly at No. 5, Esplanade East, has been removed permanently to the Government Central Book Depôt, No. 8, Hastings Street, Calcutta.

Issues.—FROM THE MAP RECORD AND ISSUE OFFICE.

Year.		On Book Transfer (to Government Officials).		On Cash Payment (to Private Individuals and Map Agents).		Free Issues.		Total.	
		Number of Printed Copies.	Value Rs.	Number of Printed Copies.	Value Rs.	Number of Printed Copies.	Value Rs.	Number of Printed Copies.	Value Rs.
1923-24	Departmental Maps.	159,179	1,74,903	64,361	97,399	52,567	89,353	276,107	3,61,655
	Extra-departmental Publications.	516,017	66,538	173,161	15,759	14,847	3,758	704,025	86,055
	Total ...	675,196	2,41,441	237,522	1,13,158	67,414	93,111	980,132	4,47,710
1922-23	Total ...	894,642	2,96,959	219,746	83,724	64,073	82,770	1,178,461	4,63,453
1921-22	Total ...	1,222,832	2,10,510	104,750	62,075	67,812	68,903	1,395,394	3,41,488

Total number of requisitions and enquiries received in the Map Record and Issue Office :—

Year 1921-22	8,868
„ 1922-23	8,860
„ 1923-24	9,303

Table III.—Publications received in Map Record & Issue Office, during the year 1923-24.

A.—From the Calcutta Printing Offices, (including the Engraving Office).

Class of Maps.	Scale.	Number of different maps of each class received.		Number of sheets printed.	Value.
		New Publications.	Reprints and New Editions.		
		DEPARTMENTAL.			
GENERAL MAPS.					*Rs.*
Maps of India	Various	...	5	16,750	3,485
GEOGRAPHICAL MAPS.					
Map of India and Adjacent Countries.	1″=32miles	...	...	...	...
Southern Asia Series ...	1:2,000,000	2	1	2,045	6,135
India and Adjacent Countries Series.	1:1,000,000	...	9	3,550	5,200
La Carte Internationale du Monde	1:1,000,000	1	1	350	350
TOPOGRAPHICAL MAPS.					
Quarter-inch, (Modern) ...	1″=4 miles	33	26	24,260	35,827
Do. (Prely.)... ...	1″=4 miles	8	3	3,400	5,100
Do. (Provl.)... ...	1″=4 miles	...	17	3,750	5,475
Half-inch, (Modern)	1″=2 miles	98	16	42,585	1,27,365
Do. (Prely.)	1″=2 miles	...	...	...	...
One-inch, (Modern)	1″=1 mile	166	38	67,537	99,969
Do. (Prely.)	1″=1 mile	20	11	8,125	12,187
Do. (Provl.)	1″=1 mile	1	1	650	775
Old Style sheets	Various.	...	60	6,075	9,621
SPECIAL MAPS.					
District Maps	1″=4 miles	...	...	...	...
Administration Report Maps ...	1″=8 miles	...	5	705	262
Provincial Maps	Various	1	2	1,838	3,502
Plans of Cities and Cantonments...	Various	2	2	1,310	3,145
Index Maps	Various	2	12	6,150	1,570
Miscellaneous Maps	Various	26	25	29,581	22,028
Total ...	.....	**360**	**234**	**218,661**	**3,41,969**
		EXTRA-DEPARTMENTAL.			
Maps	Various	275	43	134,712	42,436
Plans and Diagrams	Various	254	13	153,998	11,927
Illustrations	.....	201	1	92,138	20,402
Miscellaneous	.....	81	41	259,170	10,841
Total ...	.....	**811**	**98**	**640,018**	**85,606**
Grand Total ..	.....	1,171	332	858,679	4,27,602

B.—From the Geodetic Branch, Survey of India, Dehra Dun.

Various	Various	16	13	1,910	3,670

C.—LETTERPRESS.

1. Survey of India General Report, 1922-23. *Price Rs. 2.*
2. Hand-book of Topography, Chapter IV, 1924. *Price Re. 1.*

51. No. 1 (Head Quarters) Drawing Office.—The organization of the office remained practically the same as last year, with the exception that the Imperial Standard Mapping Section, which was directly under the administrative control of the Director, Map Publication, was placed, with effect from the 22nd January, under the supervision and orders of the Officer in charge,

PERSONNEL.

Class I Officer.

Mr. J. Prasad, R.B., in charge.

Class II Officers.

Mr. P. Williams.
" Abinash Chunder Bose.
" C. West.
" A. B. Hunter.
" Priya Nath Sur.
" Amar Krishna Mitra.
" F. B. Kitchen.
" Munshi Lal, B.A.
" H. T. Hughes.
" P. C. Mitra, B.A.

Upper Subordinate Service.

1 Officer.

No. 1 Drawing Office.

The work carried out by the various sections was as follows:—

(1) *The Compilation Section.*—

(*a*) "La Carte Internationale du Monde au 1:1,000,000".—Eight sheets were reported in hand last year and one new sheet was taken up this year. Of the nine sheets, three have been completed and sent in for publication. Contour patterns of two sheets have been completed and sent to the Engraving Office. Of the remaining four, colour pattern of one sheet, contour patterns of two sheets and preliminary compilation of one sheet are in hand. Pattern for one sheet has been prepared and sent to the Engraving Office for correction of plates for reprint.

(*b*) The Southern Asia Series, scale 1:2,000,000.—Of the five sheets reported in hand last year, layer patterns of three, outline and contour patterns of one and the outline pattern of the remaining one sheet are in hand. No new sheet was taken up this year.

(*c*) India and Adjacent Countries, scale 1:4,000,000.—Preparation of various colour patterns is in hand.

(*d*) Miscellaneous.—

(*i*) Colour patterns of the new 50-mile Wall Map of India are under preparation.

(*ii*) Black prints of plane-table sections of 33 sheets have been pasted together for supply of blue prints to various parties.

(*iii*) Three Height Indicator Scales and five originals of line blocks for Chapter VIII of the Handbook of Topography have been prepared.

(*iv*) Indexes on different scales have been brought up to date for various reports.

(2) *The One-Millionth Section.*—

(*a*) Engraved editions.—Nine sheets were reported in hand at the close of the last year and two new sheets were taken in hand during the year. Of these eleven sheets, one has been completed and sent in for publication, contour patterns of two and outline pattern of one have been completed and sent to the Engraving Office, contour pattern of one, outline patterns of three and preliminary outline pattern of one are under preparation and compilation charts of the remaining two are under examination.

Patterns for two sheets have been prepared and sent to the Engraving Office for correction of plates for reprint.

(*b*) Helio. editions.—The one sheet that was reported in hand at the close of the last year has been completed during the year and is ready for press.

(*c*) Reprints.—Originals of three sheets have been brought up to date and sent to press for reprint. This includes one reported in hand at the close of the last year.

(3) *The Quarter-Inch Section.*—

(*a*) Original compilation and drawing.—At the end of the last year there were three quarter-inch sheets in hand; one new sheet has been taken up during the year under report. Of these, three have been completed and sent in for publication and one is still in hand.

(*b*) Stump-shaded originals of 103 sheets on various scales have been prepared during the year under report, including three quarter-inch sheets that were in hand at the close of the last year. That of the 50-mile Wall Map of India which was taken up last year is nearing completion. The originals of five sheets are in hand.

(*c*) The drawing and hill-shading of the "Vivid Map of India" on the 16-mile scale were completed and the map was sent for exhibition at the British Empire Exhibition.

(*d*) The reprint of the Catalogue of Maps was taken up and the various originals and colour patterns for all the indexes and the letterpress were brought up to date and sent in for publication.

(*e*) Originals and colour patterns of the indexes and the letter-press for the Burma map catalogue have been prepared and sent to press.

(4) *The Reprint Section.*—

(*a*) 26 old style one-inch sheets (including 7 in hand at the close of the last year), 27 modern one-inch sheets (including 9 of last year) and 10 half-inch sheets have been brought up to date and sent to press for reprint; 4 old style and 2 modern one-inch and one quarter-inch sheets still remain in hand.

(*b*) Symbols on originals of 13 modern sheets have been modernised for future editions.

(*c*) 14 provisional quarter-inch sheets compiled from Indian Atlas material and 1 preliminary sheet have been brought up to date and sent to press for reprint; 1 preliminary sheet is in hand.

(*d*) Miscellaneous.—

(*i*) The 64-mile Railway Map of India has been brought up to date and sent in for reprint.

(*ii*) 2 Indian Atlas sheets and 23 miscellaneous maps (including 6 in hand at the close of last year) have been prepared and brought up to date and sent to press. 5 miscellaneous maps are still in hand.

(5) *The Mapping Section.*—

(*a*) 24 modern topographical sheets (including 2 in hand of last year) have been brought up to date and sent for reprint.

(*b*) Corrections have been carried out on the originals of 172 sheets on various scales before publication.

(*c*) Press order proof corrections have been carried out on the originals of 220 modern topographical sheets including 2 in hand of last year.

(*d*) 37 fair and print-original sheets and the colour patterns, tint originals, &c, of various special maps (including 4 in hand of last year) have been completed and sent to press. These include maps prepared for various Government and Commercial Departments. Two cases are still in hand.

(*e*) The new one-minute mesh for the General Staff has been inserted by hand on 160 printed copies of modern sheets on various scales. Mesh originals for 184 sheets on different scales, as also for 7 miscellaneous maps have been prepared.

(6) *The Office Copy Section.*—

(*a*) Additions and corrections received from various local authorities have been entered on the existing "office copies" of 2,148 sheets. 602 "office copies" of newly published or reprinted sheets have also been prepared during the year.

(*b*) The areas of 278 newly published one-inch and half-inch sheets have been checked against the Auxiliary Tables and entered in the Area Register.

(*c*) The miscellaneous work of this section includes—

(*i*) supply of authenticated copies of revenue and historical maps, revenue data from field books and other records to officials and private persons,

(*ii*) the preparation of complete sets of maps of the Districts and States of India and Burma in order to bring the "office copies" thereof up to date by references to the various Local Governments.

(7) *The Examining Section.*—

This section is responsible for the examination of the sheets drawn by other sections in the office. 165 cases pertaining to 274 sheets have been examined during the year, including 6 cases pertaining to 6 sheets in hand from last year; 13 cases pertaining to 13 sheets remain in hand.

In addition to the above current work this section has supplied scientific data to various officials, kept up corrections to Imperial Gazetteers, examined projections of sheets on copper plates in the Engraving Office, reported on boundary patterns prepared in other offices, plotted points on the plane-table section for the Mount Everest Expedition Survey, checked geographical names in various Survey of India publications, drafted and examined proofs of correction slips to the different chapters of the Handbook of Topography, Conventional Signs, Type Table, &c. The alphabetical index to names for the new 50-mile Wall Map of India which was in hand last year has also been completed during the year.

(8) *The Imperial Standard Mapping Section.*—

This section has been employed on the fair-mapping of the preliminary editions of one-inch sheets, compiled from modern revenue survey material and has completed them from old material where no modern work is available.

11 new one-inch sheets and 2 quarter-inch sheets of Bengal and Bihār & Orissa have been fair-mapped and submitted for publication; and 11 new sheets have been compiled during the year for one-inch supplementary survey by No. 4 Party in 1924-25. One partially completed one-inch sheet has been held over for want of material, 2 sheets fair-mapped but not completed, as the material was received too late, and 4 sheets still remain in hand pending receipt of material.

An area of 235 square miles in the Jherriā coal field area has been reduced from modern revenue material, and 325 square miles in the Rāniganj coal field area compiled from four-inch thana maps for supplementary survey on the four-inch scale by No. 4 Party in 1924-25.

52. Engraving Office.—(1) *Engraving Section.*—During the year under report this section has been employed in the following :—

PERSONNEL.
Class I Officer.
Mr. J. Prasad, R.B., in charge.

(*a*) *India & Adjacent Countries.*—Scale 1 : 1,000,000.

Out of the seven sheets in hand last year, one has been sent in for publication, another will be sent in very shortly, two are in final stages and two still in hand. One projected last year is awaiting material.

(*b*) *La Carte Internationale du Monde*—Scale 1: 1,000,000.

Two sheets reported in final stages last year were held back for incorporation of additional information and are expected to be ready for publication very shortly, three sheets completed are under examination and three sheets still in hand.

(*c*) *Southern Asia Series*—Scale 1 : 2,000,000.

One sheet (North Tibet) reported ready for publication last year was held back for incorporation of new information and will be completed shortly. Two sheets (Bombay and Brahmaputra) completed and under examination. One (Delhi) nearing completion and three sheets (Koko Nor, Kashmir and Calcutta) are in hand.

(*d*) The miscellaneous work has, as usual, been rather heavy. A "Warrant of Appointment" plate was engraved for H. E. the Viceroy. Office copy corrections have been carried out on maps of India on various scales and on the map of Calcutta on six-inch and three-inch scales. The conventional signs and guide card plates have been added to. All the one inch = 32 miles indexes have been corrected and brought up to date for the catalogue, and a large number of rack number labels have been hand-printed for the Map Record and Issue Office. Six steel "male dies" for the preparation of matrices for conventional sign stamps have been engraved. The compilation of the insets and a new revised colour scheme for the Wall Map of India continued throughout the year. Two new tint plates Nos. 41 and 41A have been engraved for the Photo.-Litho. Office.

(2) *Copper Plate Printing Section.*—10,934 impressions were pulled during the year, against 29,191 during the preceding year. 35 per cent. of this represents extra-departmental work such as photogravures, commission forms, &c. Of the departmental work, 30 per cent. were scales and the rest art paper prints from various plates. During the year there was a great fall in the demand for photogravures, scales, commission forms and charts.

The Electro-typing Section dealt with 56 plates.

53. Photo.-Litho. Office.—The out-turn of the office, as can be seen from the accompanying tables, is smaller than last year, which was an exceptional one owing to the large number of maps reprinted for mobilization purposes, but it is very much the same as the year before as regards the number of departmental sheets printed, *vide* Table A, column 4.

PERSONNEL.

Class I Officers.

Major F. J. M. King, R.E., in charge to 27th May 1924.

Captain T. M. M. Penney, R.E., in charge from 28th May 1924.

What does, however, show a marked decrease is the amount of extra-departmental work done. This is largely due to the general retrenchment and economy that was practised throughout every department in the course of the last year. The only branches that show an increase are the Type Section and the Process Engraving Section *vide* Table B, columns 3 and 7.

The cost of the office again shows a slight reduction.

The outstanding innovation throughout the year was the introduction of the minute mesh on maps of military areas, and the difficulties in registration encountered in surprinting the mesh on to sheets that had been for some time in stock in the Map Record and Issue Office threw an interesting light on the amount of distortion that takes place in the paper of sheets stored in this climate.

TABLE A.—WHOLE PHOTO.-LITHO. OFFICE.

1	2	3	4	5	6
Year.	*Cost of office.	Value of out-turn at office rates.	NUMBER OF MAPS PRINTED.		
			Departmental.	Other than Departmental.	Total.
	Rs.	*Rs.*			
1921-22	3,05,038	5,37,535	666	2,993	3,659
1922-23	2,64,415	5,71,286	956	2,760	3,716
1923-24	**2,63,502**	**4,56,368**	**661**	**2,016**	**2,677**

* Does not include cost of chemicals, paper, &c., obtained from England.

TABLE B.—LITHO. BRANCH.

1	2	3	4	5	6	7
Year.	Number of impressions pulled in Litho. Branch.	Number of half-tone impressions pulled.	Number of line-block impressions pulled.	TYPE SECTION OUT-TURN.		
				Pages or items published.	Copies printed.	Impressions pulled.
1921-22	3,543,470	90,633	745,670	2,854	933,391	1,766,319
1922-23	4,035,405	51,069	328,628	2,815	1,026,900	1,593,605
1923-24	**2,670,351**	**92,257**	**182,540**	**2,599**	**1,098,138**	**1,915,327**

TABLE C.—PHOTO. BRANCH.

	1921-22.	1922-23.	1923-24.
Negatives	5,894	5,604	**6,316**
Zinc plates	7,395	7,078	**6,688**
Photogravure plates ...	475	605	**820**
Half-tone blocks ...			
Line blocks			

54. Mathematical Instrument Office.—During the year from 1st April 1923 to 31st March 1924, there was a decrease in the demands made on this office for supply of instruments, and also in the value of work done in the workshop (*vide* items 1 and 6 in the statement under para. 2 below). The store made a profit of Rs. 26,348 against Rs. 63,358 in 1922-23, and the workshop Rs. 43,313 against Rs. 39,718 in 1922-23. The establishment was retrenched as per item 10 of the statement below with a view to effect economy.

PERSONNEL.
Mr. S. Woodhouse, in charge.

2. The following comparative statement shows the figures for the last 3 years :—

	1921-22.	1922-23.	1923-24.
	Rs.	*Rs.*	**Rs.**
1. Total value of stores issued to Public Offices as shown in the Profit and Loss statements.	5,32,768	6,25,953	**4,46,559**
2. Value of repairs to instruments received from Public Offices for repairs, and returned in serviceable condition.	1,18,445	1,70,010	**1,56,682**
3. Value of instruments received from Government Offices as no longer required.	58,743	83,933	**54,824**
4. Book value of the stock of instruments, &c., in the Serviceable Store.	6,91,499	5,75,844	**5,14,985**
5. Book value of the stock of instruments, &c., in the Repairable Store.	1,25,646	1,26,616	**1,11,113**
6. Total value of work done in the Workshop.	4,20,408	4,89,329	**3,92,072**
7. Value of instruments manufactured in the Workshop for Serviceable Store.	1,76,123	1,68,588	**1,14,677**
8. Value of instruments purchased locally	11,296	22,840	**13,034**
9. Value of instruments and materials obtained from England through the Director General, India Store Department.	4,58,016	2,20,650	**1,47,723**
10. Average No. of employees and their pay including pension contribution.	No. 628 Rs. 1,93,658	No. 554 Rs. 1,88,009	**No. 402** **Rs. 1,57,280**

3. During the year the stocks of the Serviceable, Repairable and Material Stores were taken twice as usual and the discrepancies found were duly adjusted. Also a good deal of surplus and obsolescent stock articles were disposed of to the best advantage of Government.

II.—DEHRA DŪN OFFICES.

GEODETIC BRANCH OFFICE.

55. Computing Office.—Computations on a large scale were carried out this year at the request of extra-departmental officers. Special mention may be made, in this connection, of a requisition for rectangular co-ordinates of about 3,000 points from the military authorities and of two others, requiring heavy computations, for the construction of maps on two-centred and three-centred azimuthal projections for the Chief of the General Staff. In addition to the above, multifarious computations, for charts (9 in number), for deducing adjustment corrections graphically, to be applied to the pendant series of triangulation in Burma, for aneroid heights, for grid co-ordinates, for plumb-line deflections on Helmert spheroid, were carried out.

PERSONNEL.

Class I Officer.

Dr. J. deGraaff Hunter, M.A., Sc.D., F. Inst. P., in charge.

Mr. Mukundananda Acharya, Head Computer and 11 other senior computers and 2 junior computers.

By request of M. Lallemand computations were made to ascertain if the mean sea level is different at adjacent tidal stations, and a note compiled for the discussion of this subject at the Madrid meeting (1924) of the International Union of Geodesy and Geophysics.

The preparation of Bombay Tidal Prediction Chronograph sheet showing both times and heights of high and low-water with values of heights computed and noted at the proper places was carried out.

The form of geoid (sea level surface) which was deduced last year and exhibited by means of contours on a $\frac{1}{5M}$ map was redrawn this year showing the elevation of geoid above Helmert-Hayford spheroid instead of above Everest spheroid as was done last year. The preparation of traverse tables in a novel form has been completed.

The tidal and geoidal charts have been exhibited at the British Empire Exhibition, Wembley.

The preparation of a revised and extended 5th edition of the Auxiliary Tables of the Survey of India is still in progress. A full edition of Part II as well as that of Part III has been printed.

Besides numerous requisitions for magnetic data, nearly 220 requisitions for various data from departmental and non-departmental officers were complied with.

Triangulation pamphlets were compiled for 67 sheets. These include both Mesopotamian Triangulation and Turco-Persian Boundary Commission work. 45 degree sheets have been printed off in pamphlet form during the year.

Magnetic Survey.—The magnetic operations, except at the Dehra Dūn observatory, were suspended in October 1923, when the Toungoo observatory was dismantled, the observatory buildings being handed over to the Director, Burma Circle.

The declination, horizontal force and vertical force magnetographs were in operation throughout the year at the Dehra Dūn observatory and daily absolute observations were taken by the observer in charge.

The results of the observations at the Dehra Dūn, Toungoo, Barrackpore, Kodaikānal and Alībāg observatories, repeat and field stations, reduced to the epochs 1909·0 and 1920·0 are now under publication.

MEAN VALUES OF MAGNETIC ELEMENTS AT THE DEHRA DŪN OBSERVATORY FOR THE YEAR 1923.

Name.	Latitude and Longitude.	Dip.	Declination.	Horizontal Force.	Vertical Force.
	° ′ ″	° ′	° ′	C. G. S.	C. G. S.
Dehra Dūn ...	30 19 19 N 78 3 19 E	45 12·6 N	1 38·6 E	0·32926	0·33168

Observatories.—Meteorological observations were continued as usual; the Omori Seismograph was in operation throughout the year and recorded 13 earthquakes.

Photographs of the sun were taken on 279 days. Photographs for 43 days could not be taken on account of repairing the dome; and for the remaining days of the year the sun was invisible.

Preservation of Trigonometrical Stations.—587 stations were repaired by district officers at a cost of Rs. 3,607. Out of 360 districts from which reports were due, 38 failed to make returns.

56. No. 2 (Dehra) Drawing Office.—During the year the work of this office was carried on by six sections. The Stein section having completed and sent to press the last of the special maps shown as in hand in the previous year, was abolished in the beginning of December 1923.

PERSONNEL.

Class I Officer.

Major W. E. Perry, M.C., R.E., in charge to 16th July 1924.

Class II Officers.

Mr. H. P. D. Morton, in charge from 17th July 1924.
Mr. H. B. Simons.
„ Rama Prasad Rav, B.A.
„ Dhirendra Nath Banerji, L.C.E.

Upper Subordinate Service.

2 Officers.

The Triangulation Chart and Cantonment Section.—Deals with the fair-drawing of triangulation, levelling and index charts, and the publication, reprint and correction of cantonment plans. In addition to the ordinary work of this section, of the 15 forest maps of Indian States received for publication at the end of last year, and shown as in hand, the accessory work on 10 of them was completed, and they have been published. Twenty-nine miscellaneous maps, charts and diagrams were also completed, and 389 sheets of cantonment plans, hand-coloured.

The Compilation Section.—Deals with the compilation and fair-mapping of geographical maps on different scales. The fair sheet on scale 1/M *viz.* No. 101 (Yunnanfu) shown as in hand last year is nearing completion. Another sheet of this series, *viz.* No. 91 (Batang), which was received from the Map Publication Office at Calcutta for the insertion of some new work, was completed accordingly and returned. The rough compilation of the 4 sheets on scale 1/M *viz.* Nos. 92 (Bhamo), 107 (Ningsiafu), 108 (Kungchangfu) and 109 (Chengtu) shown as in hand last year, together with that of another received during this year *viz.* No. 110 (Kweiyang) is proceeding. The rough compilation of the Yunnan outline sheet on scale 1/2M shown as in hand last year, and the Kashmīr contour sheet are still in progress. The remaining sheet of Sir H. H. Hayden's Tibet map has been completed and sent to press. Materials for 5 sheets of the Tibet maps *viz.* Nos. 71 NE, SE, 77 NW, SW and NE have been collected, 3 outline sheets Nos. 71 NE, SE and 77 NW are being fair-mapped, and the rough compilation of the 2 remaining outline sheets and of all the contour sheets has been commenced. A new quarter-inch sheet *viz.* No. 85 P has been taken up during the year and is in hand. The stump-shading of two sheets was taken up during the year and completed. In addition, this section supplied some plotted sheets and maps for the use of the last Mount Everest party.

Quarter-inch and Miscellaneous Section.—As the half-inch sheets allotted to this, originally the half-inch, section were completed last year, the section dealt with quarter-inch and other miscellaneous work during the year. The fair-mapping of the remaining cantonment plans *viz.* 11 of Bangalore and one of Abbottābād, shown as in hand last year was completed and the plans sent in for publication. The stump-shading of one half-inch sheet shown as in hand last year has been completed. Seven quarter-inch sheets were taken up during the year; of these, 4 *viz.* Nos. 72 M, 77 K and O and 85 O are nearing

completion, and the remainder *viz.* Nos. 85 I and J and 86 D, taken up lately, are in hand. In addition, the section dealt with 264 miscellaneous maps, diagrams and charts and completed 261, leaving the balance in hand.

The Examining Section.—Examines the majority of the important sheets drawn in this office. 529 sheets have been examined during the year (including the 22 sheets shown as in hand last year) and 5 sheets are under examination.

The Sutlej Valley Project Section.—Deals with the fair-drawing of levelling charts (showing spot heights and contours) for the Sutlej Valley Irrigation project of the Punjab Government. 130 sheets shown as the balance in hand last year have all been completed and sent to press. Materials for 321 sheets (levelled during the season 1923-24) have been received during the year; of these, 39 sheets have been completed and sent to press, leaving a balance of 282 sheets in hand.

The Map Record Section.—Deals with the storage of originals and office copies of cantonment plans, triangulation and other charts and geographical maps; it keeps a small stock of the various maps published by the department for occasional issue to the public and for departmental use, and deals with all correspondence on this subject.

Summary of the work of the office during the year 1923-24.

Class of maps.	Balance of sheets on 1st October 1923.	Sheets received in 1923-24.	Sheets sent to press in 1923-24.	Balance of sheets in hand on 1st October 1924.	REMARKS.
Triangulation charts ...	12	15	19	8	
Levelling charts ...	2	1	2	1	
Index charts to illustrate reports.	1	3	4	...	
Cantonment plans for publication.	75	118	130	63	
Cantonment plans for correction.	20	140	160(*a*)	...	(*a*) Corrections carried out in both originals and office copies.
Cantonment plans fair-drawing.	12	...	12	...	

Summary of the work of the office during the year 1923-24.—(concld.).

Class of maps.	Balance of sheets on 1st October 1923.	Sheets received in 1923-24.	Sheets sent to press in 1923-24.	Balance of sheets in hand on 1st October 1924.	REMARKS.
Forest maps of Indian States for publication.	15	5	10	8(*b*)	(*b*) Two maps returned to the Director, Southern Circle.
Miscellaneous maps, charts and diagrams.	4	289	290	3	
Colour guides of cantonment and other maps.	202	225	389	38	
Quarter-inch sheets ...	...	8	...	8	
Sutlej Valley project level and contour charts, scale 4 inches = 1 mile.	130	321	169	282	
GEOGRAPHICAL MAPS.					
Fair sheets, scale 1/M ...	1	1	1	1	
Rough compilation, scale 1/M.	4	1	...	5	
Rough compilation, scale 1/2M.	1	...	...	1	
Stump-shading, various scales.	1	2	3	...	
Sir H. H. Hayden's Tibet map.	1	...	1	...	
Maps of Tibet, scale 1 inch = 8 miles, fair sheets, outline.	...	3	...	3	
Rough compilation, outline sheets.	...	5	3(*c*)	2	(*c*) Being fair-mapped.
Rough compilation, contour sheets.	...	5	...	5	
Sir Aurel Stein's explorations in Chinese Turkistān and Kansu in 1900-01, 1906—08 and 1913—15, for publication on 2/M scale.	1	...	1(*d*)	...	(*d*) In final proof stage.

57. Forest Map Office.—As the result of the Indian Retrenchment Committee's recommendations, the Government of India decided that from the 1st of April 1924, the whole cost of this office should be debited in the Survey of India budget and, with the object of placing the office on a self-supporting basis, that its full cost (less receipts) should be distributed between Provincial Governments employing it, and the Central Government, in proportion to the reserved forest areas under them.

PERSONNEL.

Class I Officer.

Major W. E. Perry, M.C., R.E., in charge to 16th July 1924.

Class II Officers.

Mr. H. P. D. Morton, in charge from 17th July 1924.
,, Asmat-ullah Khan, K.B.
,, A. B. Hunter.
,, T. F. Kitchen.
,, N. N. Chuckerbutty, L.C.E.
,, Nanak Chand Puri, B.A., R.S.

Upper Subordinate Service.

1 Officer.

The strength of the office and its organization remained practically the same as last year.

The work carried out by the various sections was as follows:—

(1) *The Drawing Section.*—The progress of this section is shown in the table below:—

Class of map.	In hand on 1st October 1923.	Received during the year.	Drawn and sent for publication during the year.	In hand on 30th September 1924.	Published during the year.	Total number of copies printed.
(*a*) ...	20	39	59	0	70	19,315
(*b*) ...	*34	25	50	‡6	51	
(*c*) ...	*0	2	2	0	3	
(*d*) ...	*1	6	7	0	9	
(*e*) ...	2	3	5	0	6	
(*f*) ...	25	13	2	§36	3	
(*g*) ...	*0	30	†26	4	17	
Total 1923-24.	**82**	**118**	¶151	**46**	**159**	
Total 1922-23.	...	160	¶164	...	218	21,688

* Figures as amended.
† 11 of these are hand-corrected prints and are not for publication.
‡ Publication of 3 maps was cancelled during the year.
§ 2 of these are to be hand-corrected and are not for publication.
¶ Includes two-inch and four-inch forest maps drawn by Survey parties.

(*a*) Reprints of forest maps on various scales.
(*b*) Forest editions on the two-inch scale of modern one-inch maps.
(*c*) Maps of Forest Circles and Divisions.
(*d*) Maps to illustrate working plans, etc.
(*e*) Maps and diagrams to accompany Administration Reports.
(*f*) Forest maps from special surveys, mostly on the four-inch scale.
(*g*) Index and miscellaneous maps.

(2) *The Portfolio Section.*—Office copies of 496 maps and colour specimens of 30 maps were prepared; corrections to 216 sheets were completed, 83 office copies were coloured up and 959 sheets were hand-coloured for issue on indent. In addition this section corrected the forest information on 60 maps for the various Survey of India drawing offices requiring them for compiling the half-inch and degree sheets, and corrected 425 forest maps for No. 8 Party for survey in season 1924-25.

(3) *The Map Record Section.*—The number of maps, diagrams and original fair sheets received for storage was 9,901; 4,855 maps, &c., valued at Rs. 12,721 were issued gratis. Sales by book-transfer to Government departments amounted to Rs. 5,931 for 1,708 maps; these figures show an increase of 681 maps and Rs. 2,794 over those for last year. Cash sales to the public amounted to Rs. 1,443 for 653 maps, a decrease of Rs. 592 from the amount realized the previous year.

(4) *The Book-Binding Section.*—This section as a special case dealt with 9 volumes for the Forest Research Institute, the value realized by cash being Rs. 26; 2,151 maps of various sizes were mounted on cloth for issue.

Miscellaneous.—At the special request of the Conservator of Forests, Northern Circle, Central Provinces, and of the Divisional Forest Officers of the South Raipur and Hoshangābād Forest Divisions, the area statements of the reserved forest areas in 94 four-inch sheets were revised.

The list of forest triangulation and traverse data was completed and sent to press. The revised catalogue of maps published by the Forest Map Office is still in press, and copies are expected to be ready shortly for issue.

58. Photo.-Zinco. Office.—During the year 1923-24 the work undertaken comprised:—

Cantonment plans.

Index and Triangulation charts.

Forest maps.

Miscellaneous maps.

Extra-departmental maps.

It deals also with the despatch of sheets printed in the section and with all the correspondence on the subject. The Sutlej Valley charts reproduced by the vandyke process kept the section fully occupied.

Years.	No. of Subjects.	No. of Negatives.	No. of Pulls.	No. of Chocolate and Bromide prints.
1921-22 ...	1,480	2,028	305,415	*Nil.*
1922-23 ...	1,719	1,580	318,229	1,198
1923-24 ...	**1,270**	**1,680**	**374,954**	**55**

59. Type Printing Section.—The following were printed during the year:—

1. Records of the Survey of India, Volume XVIII, 1921-22.
2. Tide-tables for Indian Ports, 1925.
3. 45 Triangulation pamphlets.
4. Levelling pamphlet 79 and new data for pamphlets 43, 53, 54, 55 and 73.
5. Hand-book of Topography, Chapters II and III (both revised).
6. Auxiliary Tables, Parts II and III (both revised and extended).
7. Type Book of the Geodetic Branch, Survey of India.

The following are in hand :—

(1) Records of the Survey of India dealing with the Magnetic Survey of India.

(2) Tidal Chapter of the Trigonometrical Hand-book.

(3) Levelling pamphlet 44 (revised and extended).

(4) Narrative Report of the Bhutān and South Tibet Survey Detachment by Captain H. R. C. Meade, I.A.

(5) Forest Map Office Record Book.

III.—CIRCLE AND LOCAL DRAWING OFFICES.

60. No. 3 Drawing Office (Northern Circle).—During the year 2 two-inch sheets, 56 one-inch sheets out of 60 and 15 half-inch sheets out of 20 previously surveyed, were fair-mapped by parties and have been submitted for publication.

PERSONNEL.

Class I Officer.

Mr. J. A. Freeman, in charge to 1st January 1924, and again from 2nd September 1924.

Class II Officers.

Mr. P. A. T. Kenny, O.B.E., in charge from 2nd May to 1st September 1924.

Mr. E. B. West, in charge from 2nd January to 1st May 1924.

Mr. A. A. Graham.

Upper Subordinate Service.

1 Officer.

Lower Subordinate Service.

54 Draftsmen, etc.

Half-inch sheets compiled from one-inch sheets.—11 half-inch sheets were fair-drawn in the Circle Drawing Office, and have been submitted for publication during the year.

Modern material available.—The fair-mapping of 16 half-inch sheets, of which the component two-inch and one-inch sheets have been published or sent for publication, is in hand. In addition to the above there are 16 half-inch sheet areas, of which the component two-inch or one-inch sheets though surveyed, have not been published. The material for these areas will shortly be available for fair-mapping.

Quarter-inch sheets compiled from modern one-inch and half-inch sheets.—During the year 7 quarter-inch sheets were fair-mapped and submitted for publication.

Modern material available.—The fair-mapping of 4 quarter-inch sheets, of which the component one-inch or half-inch sheets have been published, is in hand. There are, besides the above, 11 quarter-inch sheet areas, of which the component one-inch and half-inch sheets, though surveyed, have not been published.

Special maps.—During the year, the Lucknow and Environs map in four sheets, the Mussoorie-Simla road map on four-inch and six-inch scales respectively, and the Bhatta village (Mussoorie) project survey, scale one hundred feet to the inch, were fair-drawn and submitted for publication.

The colour patterns of the Lucknow and Environs map and of the Mussoorie-Simla road map were prepared and sent for publication.

Hill-shaded sheets.—29 one-inch, half-inch and quarter-inch sheets were stump-shaded and submitted for publication.

Layer guides.—Nil.

Colour patterns and press order proofs.—During the year 107 colour patterns of two-inch, one-inch, half-inch and quarter-inch sheets were prepared and submitted for publication.

Miscellaneous.—The traverse plots of "*mauzas*" in 4 sheets of Basti and Gondā districts, on the sixteen-inch scale, were supplied and the cost of preparation recovered from the Deputy Commissioners of the respective districts.

For the purpose of reprint the office copies of 62 sheets were corrected and submitted for publication.

During the year 78 published sheets on various scales were sold to the public at a cost of Rs. 128.

Record Section.—During the year the compilation of topographical triangulation data falling in 11 degree sheets was completed, that of 5 other sheets is in hand.

Topographical triangulation and traverse data were extracted and supplied to various other departments.

61. No. 4 Drawing Office (Southern Circle).—During the year 37 one-inch and 9 half-inch sheets previously surveyed and mapped and 9 one-inch sheets and one half-inch sheet surveyed and mapped during the year under report which were received from parties before the 30th September 1924 were finally examined and submitted for publication; out of these 6 one-inch sheets, which were received in an incomplete state from the party concerned, were completed before being submitted for publication. There are no arrears.

PERSONNEL.
Class I Officer.
Mr. J. O'B. Donaghey, in charge.
Class II Officer.
Mr. E. Claudius.
Upper Subordinate Service.
3 Officers.
Lower Subordinate Service.
44 Draftsmen, etc.

Half-inch sheets compiled from modern one-inch sheets.—13 sheets were mapped and submitted for publication. Including 4 being mapped by parties there are 13 sheets in hand of which one will shortly be submitted for publication.

Modern material available.—The material for 2 half-inch sheets has been received but the mapping has not yet been commenced. The material for one half-inch sheet of which the component one-inch sheets have been published has been called for. In addition there are 7 half-inch sheet areas of which the component one-inch sheets have been submitted for publication but are not yet published, and 16 half-inch sheet areas completely surveyed on the one-inch scale but of which all the component one-inch sheets have not yet been submitted for publication.

Quarter-inch sheets compiled from modern one-inch and half-inch and old style sheets.—8 sheets were mapped and submitted for publication. There are 3 sheets in hand.

Modern material available.—There are 6 quarter-inch sheet areas of which the component half-inch sheets have been submitted for publication, 3 quarter-inch sheet areas of which the component half-inch sheets have been mapped or are in hand but have not all been submitted for publication and 10 quarter-inch sheet areas completely surveyed but of which the mapping of all the component half-inch sheets has not yet been commenced.

Reprint sheets.—There are no reprint sheets in hand. Office copy corrections were entered on No. 1 Drawing Office's office copies of 4 sheets which are being reprinted.

Colour patterns.—These were prepared for 96 sheets and submitted for publication. There are no arrears, the colour patterns of one sheet of which proofs were lately received are in hand.

Hill-shaded sheets.—These were prepared for 81 sheets and submitted for publication. Prints for 8 sheets are in office, 4 of these are in arrears and 4 sheets are in hand.

Layer guides.—Nil.

Photo.-Zinco. work.—

Number of reproductions	235
,, ,, enlargements	195
,, ,, reductions	446
,, ,, vandyked plates prepared	224
,, ,, prints pulled	7,364

Work for private individuals on cash payment was done to the value of Rs. 170.

Special maps.—6 two-inch sheets of the special forest survey of Hyderābād (Deccan) surveyed and mapped by No. 6 Party were received before the 30th September 1924 for final examination, these will be finally examined and submitted for publication on receipt of plane-table sections which are at present in use in the party for half-inch mapping. 8 two-inch sheets of the special forest survey of Hyderābād which were finally examined and submitted for publication last year were received back from the Publication Office together with proofs, the press order proofs of 6 of these sheets have been examined and submitted for publication together with the fair sheets

on which necessary corrections were carried out, the proofs and fair sheets of the remaining 2 sheets have been examined and corrected and will shortly be submitted for publication. 3 one-inch special forest sheets of Indore and Dhār States previously surveyed and mapped were received from No. 5 Party, these three sheets were finally examined and submitted for publication.

Proofs together with the fair sheets of 11 one-inch special forest sheets were received from the Publication Office, all these proofs were examined and submitted for publication after the necessary corrections had been carried out on the fair sheets. The publication of 3 one-inch special forest sheets is being undertaken by this office, the printing of these is now in hand. The colour patterns of 14 one-inch and 8 two-inch special forest sheets have been prepared, the coloured copies of these and of all future similar sheets will be prepared by hand in this office on receipt of uncoloured published prints from the Publication Office.

The three-inch road map of Bangalore mentioned as being in hand in last year's report has been cancelled in favour of a three-inch town map; the preparation of the necessary reductions, the inking up of blue prints of existing large scale surveys and other miscellaneous work for this map have been carried out by this office. The field work in connection with it will be undertaken shortly by No. 7 Party.

Triangulation charts and computations.—Six triangulation pamphlets with charts and topographical data complete were prepared in draft form and are ready for fair copying and despatch to the Director, Geodetic Branch, when called for by him. The preparation of two triangulation pamphlets in draft form is in hand. Material was extracted and supplied to (*a*) the parties of the Southern Circle (*b*) the Director, Northern Circle (*c*) the Director, Madras Survey (*d*) the Bhopāl Government (*e*) the military authorities for various Artillery Practice Camps (*f*) the General Staff, Poona (*g*) the 'Senior Officers' School at Belgaum. The revision of the register of triangulation and traverse records is still in hand.

Miscellaneous.—The sorting and arranging of records and copies of published sheets has been completed.

Published copies of sheets were sold to the public to the value of Rs. 865.

62. No. 5 Drawing Office (Eastern Circle).—The following sheets were received from field parties during the year :—

PERSONNEL.

Class I Officer.
Mr. W. M. Gorman, in charge.

Class II Officer.
Mr. B. M. Berrill.

Upper Subordinate Service.
3 Officers.

Lower Subordinate Service.
27 Draftsmen, etc.

Four-inch sheets	...	1
One-inch ,,	...	22
Half-inch ,,	...	6
Quarter-inch ,,	...	4
Total	...	33

All the above sheets were submitted for publication except one one-inch and one four-inch sheet.

The 4 quarter-inch sheets were drawn and completed to edge from old surveys.

Half-inch sheets compiled from modern one-inch and old style sheets.—During the year, 18 sheets were in hand, including 10 from last year; of these 11 were submitted for publication, leaving 7 in hand.

Modern material available for half-inch mapping.—All sheets of which the component 1-inch sheets are either published or under publication have been put in hand.

Quarter-inch sheets compiled from modern one-inch, half-inch and old style sheets.—Five sheets were in hand, including one from last year, of which 2 were submitted for publication leaving 3 in hand, 2 of which are held up pending new survey to be undertaken in 1924-25.

Modern material available for quarter-inch mapping.—All material, of which the half-inch component sheets are published or under publication, has been put in hand.

Layer guides.—One was received and submitted.

Colour patterns and press order proofs.—Those of 51 sheets including 5 recalled from last year were received and 46 dealt with, leaving 5 in hand unavoidably delayed due to changes by local officials in boundaries and names.

Triangulation charts and traverse data.—The circle office triangulation records were registered and indexed on the card system and traverse record volumes for sheets 78 P, 83 B, C, D, F and J were prepared. The tabulating in synoptical form of all modern minor triangulation and the preparation of pamphlets for the area in the vicinity of the frontier as also of the traverse record volumes of Aijal, Dum-Dum, Barrackpore and Ichāpur (Ishapore) and the registering and indexing of other traverse volumes still remain to be done.

63. No. 7 Drawing Office (Burma Circle).—This office was formed on the 2nd October 1923 from the existing Maymyo Drawing Office. During the year 8 two-inch, 12 one-inch and 2 half-inch sheets, surveyed in 1922-23 were received from field parties, and were finally examined. With the exception of 3 one-inch sheets, all were submitted for publication during the year. Of sheets surveyed in 1922-23, there still remain 3 two-inch forest sheets, retained with the party for entry of new boundaries. None of the sheets surveyed in 1923-24 were submitted by the 30th September 1924.

PERSONNEL.
Class II Officer.
Mr. W. G. Jarbo, in charge.
Upper Subordinate Service.
1 Officer.
Lower Subordinate Service.
18 Draftsmen, etc.

Half-inch sheets compiled from modern one-inch sheets.—8 half-inch sheets were drawn and completed in No. 7 Drawing Office during the year. 3 others are in hand.

Modern material available for half-inch mapping.—There are 2 modern half-inch sheets, of which the component one-inch sheets have been published and 2 others of which the one-inch sheets have been submitted for publication, the drawing of which has not yet been put in hand.

Quarter-inch sheets compiled from modern half-inch sheets.—One of these sheets is in hand.

Modern material available for quarter-inch mapping.—There are 8 quarter-inch sheets of which the component half-inch sheets have been published or sent for publication.

Colour patterns and press order proofs.—These have been received for 9 one-inch and 7 half-inch sheets, and were all completed and submitted. In addition to these the colour patterns of 17 special 2-inch forest sheets were prepared and submitted.

Preparation of Forest Index showing Gazetted Reserves.—This index, on the one-millionth scale, which was begun last year, was completed during the year.

64. No. 6 Drawing Office (Simla).—The *Survey Section* has been employed on the compilation and fair-drawing of trans-frontier maps on the one-millionth, half-inch and quarter-inch scales, and incorporating additional survey and information on sheets previously published.

PERSONNEL.
Class I Officer.
Major L. G. Crosthwait, I.A., in charge.
Class II Officers.
Mr. F. H. Grant.
,, H. H. P. Butterfield.
Army Section.
4 European Draftsmen.
3 Printers.
Survey Section.
2 Clerks.
18 Draftsmen.

During the year 5 1/M sheets, 24 quarter-inch and 3 half-inch sheets were compiled, fair-drawn and submitted for publication; 5 quarter-inch and 4 half-inch sheets were sent for publication of new editions after new material and information had been added.

Press order proofs of 38 sheets were examined and colour patterns prepared.

The *Army Section* is employed on the preparation and printing of maps and plans for the Army and other Government Departments.

During the year 353 maps and plans were dealt with and 61,696 copies printed on the litho-printing presses.

PART 4.—WORK FOR LOCAL GOVERNMENTS AND OTHER GOVERNMENT DEPARTMENTS.

65. Northern Circle. No. 22 (Riverain) Party.—The party continued the work of traversing and laying down base lines. 269 linear and 641 square miles of main-circuits along the Indus river in Miānwāli and Dera Ismail Khān districts and 2,727 linear miles and 569 square miles of minor traverse in the Chenāb riverain tract in Jhang district were executed, 412 theodolite stations of the former and 13,243 of the latter in 190 villages were fixed. 468 corners of 156 squares in 502 square miles were demarcated with permanent mark-stones on both banks of the Chenāb river in Jhang district, to serve as bases for future survey and demarcation of boundaries and fields in the bed of the river. 1,815 plotted and 369 boundary *masāvis* (settlement mapping sheets) on the scale of 1/2,640 and 29 four-inch sheets were traced and supplied to the Settlement Officer, Jhang. Besides these 311 boundary *masāvis* were partly compiled on the scale of one inch = 220 feet for the next field season's work, and 165 miscellaneous traces were prepared. All the traverse stations marked during the field season were plotted on 29 four-inch sheets.

PERSONNEL.

Class I Officer.

Mr. Dhani Ram Verma, R.S., in charge.

Upper Subordinate Service.

3 Officers.

Lower Subordinate Service.

36 Traversers, etc., (excluding 25 purely temporary men).

66. No. 23 (Punjab Rectangulation) Party.—During the year the party was employed on rectangulation in connection with the Punjab Government's Sutlej Valley project in the Multān, Montgomery, Lahore and Ferozepore districts and in Bahāwalpur State.

A total area of 5,540 square miles was rectangulated and 35,000 corner stones of 100-acre rectangles were embedded. In an area of 3,585 square miles 3,233 linear miles were traversed in advance for the purpose of laying down the corners of 2,400-acre rectangles.

PERSONNEL.

Class I Officers.

Major R. Foster, I.A., in charge to 5th May 1924.

Major J. D. Campbell, D.S.O., R.E., in charge from 6th May to 30th June 1924.

Mr. E. C. J. Bond, V.D., in charge from 1st July 1924.

Class II Officers.

Mr. Maya Das Puri, R.S.

,, A. M. Talati, L.C.E.

,, F. W. Smith.

,, C. O. Picard.

,, Abdul Karim, B.A.

,, G. A. Norman.

Upper Subordinate Service.

3 Officers.

Lower Subordinate Service.

21 Traversers, etc., (excluding 138 purely temporary traversers).

The country under rectangulation comprises three separate areas :—

(1) The area included in the Lahore, Montgomery and Ferozepore districts, bounded on the north by the old bed of the Beās river from the north of Pākpattan to Kasūr; on the east from Kasūr to Ferozepore; on the south from Ferozepore to the junction of the Ferozepore-Bahāwalpur and Bīkaner boundaries and thence along the Bahāwalpur State boundary to the south of Pākpattan. In this area the country is well cultivated, is irrigated by canals and interspersed with patches of thick forest.

(2) The area in the Bahāwalpur State included between the Indus and Panjnad rivers and the railway line from its junction with the Sukkur district boundary to Chaudri railway station; and the area in the Cholistān between the railway line and the old bed of the Hakra river from a point 25 miles east of Khānpur to a point on the Bahāwalpur State boundary south-east of Takht Mahal railway station. The country included in this area is mostly a sandy desert in which water is scarce.

(3) A narrow strip of land in the Multān district north and south of Jalālpur Pirwāla and between the Sutlej river and the old bed of the Beās river. This strip of land is well cultivated and interspersed with patches of jungle.

In recess the party was employed on the compilation of "*masāvis*" of the area rectangulated, traverse computations and the preparation of material for the ensuing field season.

67. The Settlement Survey Detachment.—With a view to assisting the Settlement Officers, Peshāwar and Attock, the Settlement Survey Detachment was formed experimentally on the 1st February 1924, as a part of No. 3 Party (N. C.); and was made an independent unit with effect from the 1st June 1924.

PERSONNEL.

Class II Officers.

Mr. Maya Das Puri, R.S., in charge.
" Abdul Karim, B.A.
" Narendra Nath Chuckerbutty, L.C.E.

Upper Subordinate Service.

2 Officers.

Lower Subordinate Service.

19 Surveyors, Traversers, etc.
(excluding 45 purely temporary men).

The old settlement maps were examined and their defects pointed out to both the Settlement Officers. The whole of the Mardān and Chārsadda *tahsīls* in the Peshāwar district and some hilly portions of the Attock *tahsīl* were taken up in the middle of the field season under difficult circumstances, due to the inexperience of the traversers and the difficulty of preventing camps being robbed.

At the special request of the Settlement Officer, Peshāwar, field operations were continued during the hot weather so that all the plots of both the *tahsīls* could be supplied by early next winter to enable him to finish the detail survey during the season 1924-25 for assessment purposes.

The maps of 454 villages were reduced by pentagraph to the one-inch scale and compiled on 23 one-inch topographical sheets.

In all 4,197 linear miles of main and minor traverses in 854 square miles (356 in Chārsadda and 498 in Mardān) of 270 villages of the Peshāwar district; and 398 linear miles in 74 square miles of 13 villages of the Attock *tahsīl* were traversed; and 17,256 stations in the former and 1,837 stations in the latter were laid out on the ground. Only 467 square miles of the Peshāwar district were computed and plotted; and 1,350 plotted *masāvis* (settlement mapping sheets) on the scale 24 inches to a mile and 128 four-inch village indexes were supplied to the Settlement Officer, Peshāwar. In the Attock *tahsīl* the whole area, *viz.*, 74 square miles, was completed; and 320 plotted *masāvīs* of 13 villages on the scale 32 inches to one mile, and 13 four-inch indexes were supplied to the Settlement Officer, Attock. Besides these 650 miscellaneous traces were prepared and all the work done during the year was plotted on 42 four-inch sheets.

The ground in the Peshāwar district was flat, highly fertile, and well irrigated; while in Attock the area was scattered, broken, and poorly cultivated.

68. Southern Circle. No. 5 Party.—At the request of the Commandant, Royal Artillery, Southern Command, a surveyor fixed additional points in the Sailānā Artillery Practice Camp for artillery ranging purposes.

69. Eastern Circle.—In addition to his duties in the Imperial Department, the Director, as Director of Surveys, Assām, held administrative charge of the Assam Survey Department, including the Assam Traverse Party, the Drawing and Reproducing Offices at Shillong and the Assam Survey School at Jhālukbari; also in his capacity as technical adviser on survey matters to the Government of Bengal he visited the Bengal Traverse Party in the field.

70. No. 12 Party.—During the year, at the request of the Assam Government, surveyor Singhbir Thāpa accompanied

Mr. J. H. Hutton, C.I.E., I.C.S., Deputy Commissioner of the Nāga Hills district, in a tour in the unadministered Nāgā tribal area almost as far as the main range forming the Assam-Burma boundary and carried out a reconnaissance survey on the half-inch scale of an area of 1,351 square miles, which has been included in the party's mapping programme for the year.

71. Geodetic Branch.—At the request of the Chief Engineer, P. W. D. (Irrigation), Burma, 593 miles of levelling of precision were executed.

For the Punjab Government, 659 miles of secondary and 31,865 miles of tertiary levelling in connection with the Sutlej Valley Irrigation project covering about 4,800 square miles were completed. The preparation and printing of contoured charts for the same project is in progress.

At the request of the Burma Oil Company, Messrs. K. K. Das, B.A., and Jugal Behari Lal were deputed for a period of 4½ months to assist Dr. Pekar, Geophysicist of Budapest, in a gravity survey with the Eötvös torsion balance in Khairpur State and Sukkur District (Sind).

In recent years the data obtained by this instrument have been found useful in the elucidation of geological structures concealed beneath alluvium.

72. Head Quarter Offices.—The total out-turn of all extra-departmental publications during the year for the Army, for Local Governments and for other government offices is given in Table A of the Photo.-Litho. Office report on page 45, in the "Issues" table and in Table III of the Map Record and Issue Office report on pages 37 and 38.

In addition to the special maps for other departments which are mentioned in para. 49(*g*) on page 36, these extra-departmental publications include maps to illustrate the various reports of government officials, maps for railway guides, and for posting in railway carriages, &c. The usual large numbers of weather charts for the Meteorological Department and of the photogravure and half-tone illustrations for the Archæological and other departments were also printed.

The work entailed by the preparation of originals for some of these special maps, in addition to their publication, is mentioned in the reports of No. 1 Drawing Office and of the Engraving Office on pages 39 to 44.

73. Mathematical Instrument Office.—Repairs to range-finders, binoculars, telescopes, sight dials, &c., manufactures of articles and calibration of gun-clinometers were carried out for the Army; also a large number of microscopes were repaired for the Medical department in addition to the general repair and manufacture work for other civil departments.

74. No. 6 Drawing Office (Simla).—In addition to its normal work for the Army, this office has prepared maps and plans for the Foreign and Political, Home, Legislative and Meteorological Departments, Census Commissioner of India, Government Press, Public Health Commissioner and Punjab Hydro-Electric Survey.

APPENDIX.

COLONEL C. H. D RYDER, C.B C.I.E., D.S.O., R.E.

The Department has lost one of its most distinguished officers by the retirement, on the 28th of September, of the late Surveyor General, Colonel C. H. D. Ryder, C.B., C.I.E., D.S.O. R.E.

He joined the Department as a Lieutenant on November the 20th, 1891, with nearly 5½ years' service, of which over 3 years had been spent in India. During his career in the Survey of India, he did topographical work in various parts of India and Burma, and the following summary will show his exceptional record as an explorer in nearly all the countries of Southern Asia:—

1894-95. One of the Survey officers attached to the Mekong Boundary Commission.

1898—1900. Explorations in Yunnan—Twice across China from Burma, the first time ending up *via* Tonking, and the second year working down the Yangtze river during the Boxer rebellion, and finally joining up with the China Field Force, where he was present at the actions of Pei-tsang and Yangtsun and at the relief of the Peking Legations. For his reconnaissance work he received the thanks of H. E. the Commander-in-Chief, and for war service the medal with clasp and a mention in despatches.

1903—05. Accompanied the Tibet Expedition to Lhāsa—Medal with clasp, D.S.O., and mentioned in despatches—From Lhāsa worked along the Brahmaputra and Sutlej valleys, behind the Himālayas, to Simla—Awarded gold medals by the Royal Geographical Society and the Geographical Society of France, and a silver medal by the Scottish Geographical Society.

1913-14. Senior Survey Officer with the Turko-Persian Boundary Commission, and later Deputy Commissioner as well, being in charge of the operations on the outbreak of the War, when the Commission was broken up and he proceeded to England *via* Russia—Awarded the C.I.E.

Apart from this remarkable record, Col. Ryder will be held in lasting memory by the Department on account of his valuable services as an administrator. In 1906 he was selected to hold the newly formed post of Superintendent, Frontier Surveys, which was, next to that of Surveyor

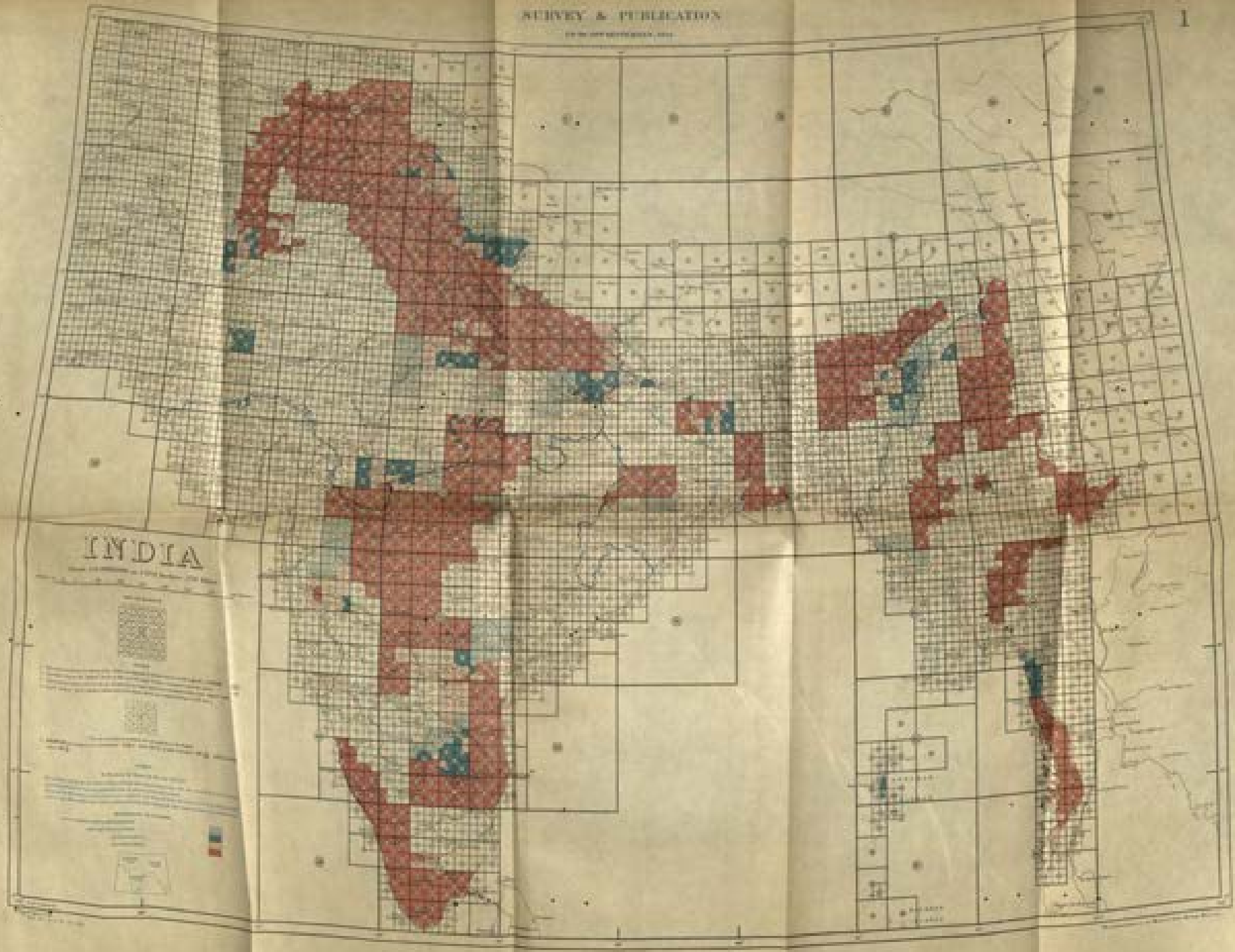
General, the most important post in the Department. His tact and ability in administering the six Frontier Parties, and afterwards the Northern Circle, were an important factor in building up the improved traditions of work which the Department has been able to evolve since it was granted the improved organisation of 1906. Later on, 1915 to 1918, he held the post of Superintendent, Map Publication, in Calcutta during the most difficult period of the War. The success with which the Calcutta Offices responded to the heavy strain which was put upon them owing to War demands by the Army and many other Departments, was largely due to his excellent administration for which his services were brought to the notice of the Government of India. He was then posted as Director of Survey Operations in 'Iraq, where he effected notable improvements in organisation and procedure (1918-19), and was mentioned in despatches.

Col. Ryder finally succeeded to the post of Surveyor General on the 16th of March 1919, where his patience, ability, and solid good judgment were invaluable in facing post-war problems and in getting the Department properly re-established on a peace footing. This difficult work was embarrassed, firstly by the necessity of re-adjusting the pay, etc., of all services owing to the rise in prices, and latterly by problems of retrenchment and finance; but in spite of all difficulties, the re-establishment of the Department has been carried through with admirable success, and it has been handed over in a condition which should provide an excellent foundation for all future developments.

In addition to this patient work of re-construction, which was combined with the perfecting of a great variety of details of procedure and technique, a very notable improvement has been effected in departmental organization by the detachment of Burma from the Eastern Circle to form a separate Survey Circle, in April 1923. This new Burma Circle has already justified its existence in many ways, and should lead to valuable developments which would have been otherwise quite impossible.

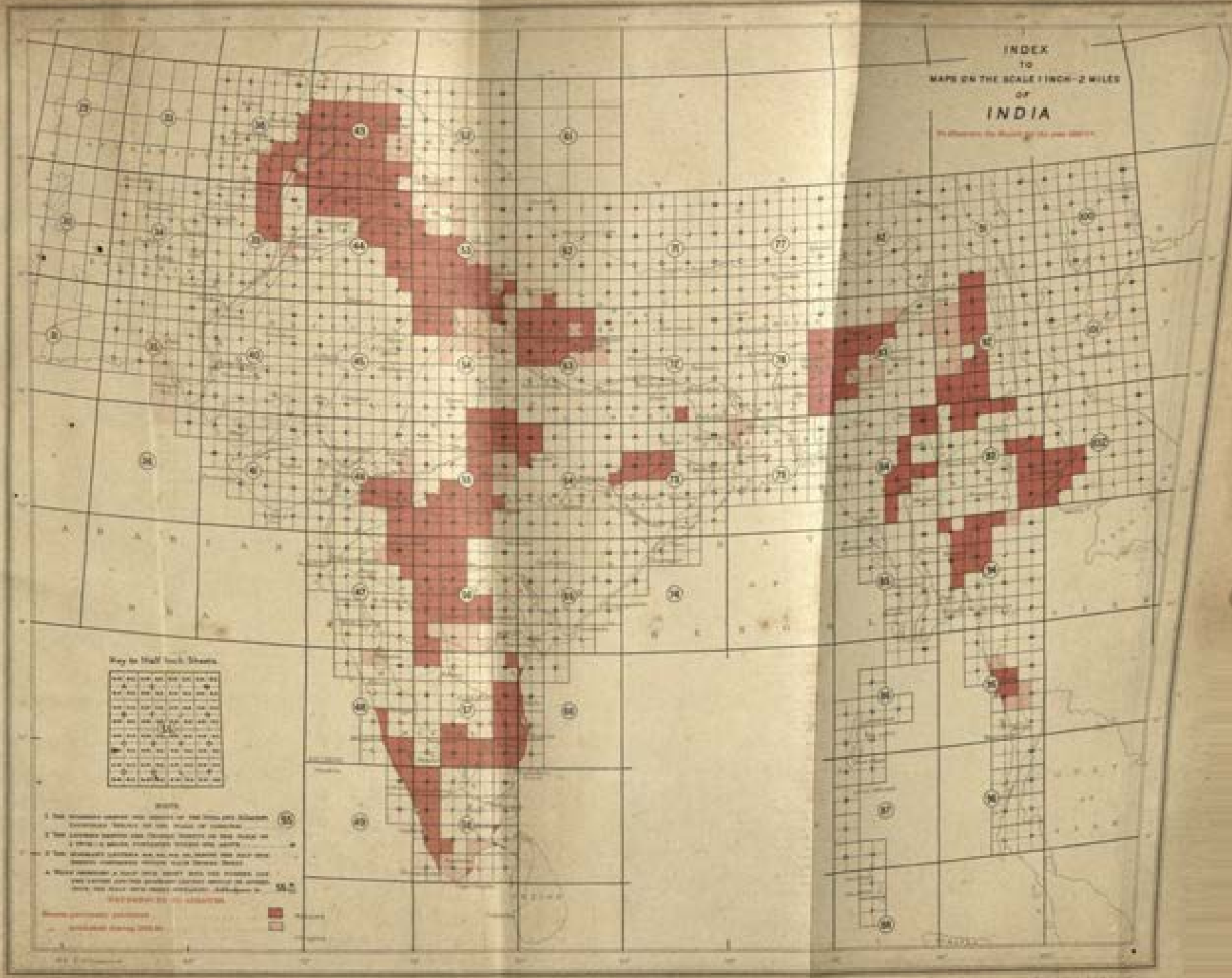
On the human side of administration, Col. Ryder set a most valuable example in dealing with difficult personal problems, and always commanded the complete confidence of those who had the pleasure of working with him. He was awarded the C. B. (Military) in 1922, and his services as Surveyor General were extended for a period of 9 months after attaining the age of 55.

SURVEY & PUBLICATION

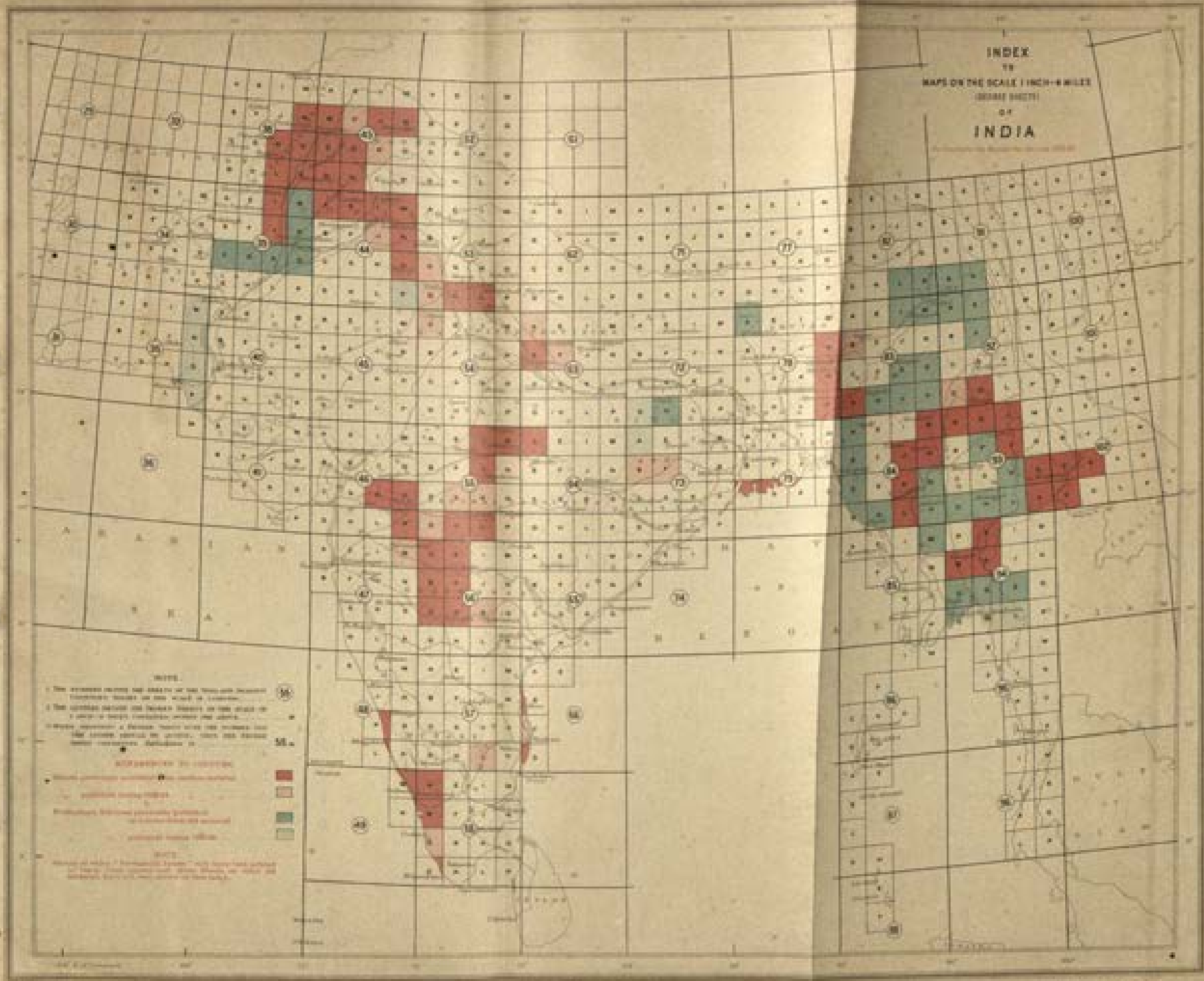


SURVEY & PUBLIC

INDIA


INDEX
TO
MAPS ON THE SCALE 1 INCH = 2 MILES
OF
INDIA
Key to Half Inch Sheets.

HALF INCH SERIES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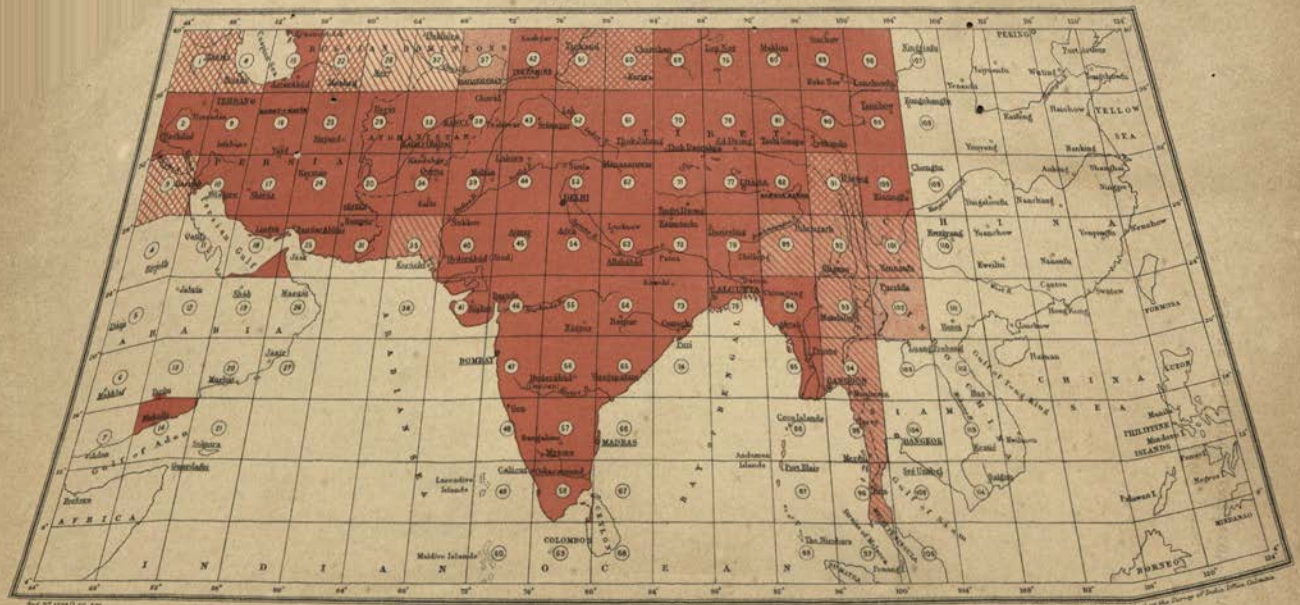
DEGREE SHEET SERIES

Scale 1 Inch to 4 Miles.



NOTE.

The names underlined on this Index are the title names of the sheets, and their numbers are shown in circles. Sheets 35 and 36, 57 and 66, are published respectively as combined sheets.

Scale 'REDUCE'

Miles 200 0 200 400 600 800 Miles

REFERENCE.

To illustrate the Report for the years 1923-24.

Sheets published without contours & Layers

Sheets published with contours & Layers

Sheets under publication

Sheets not published

5

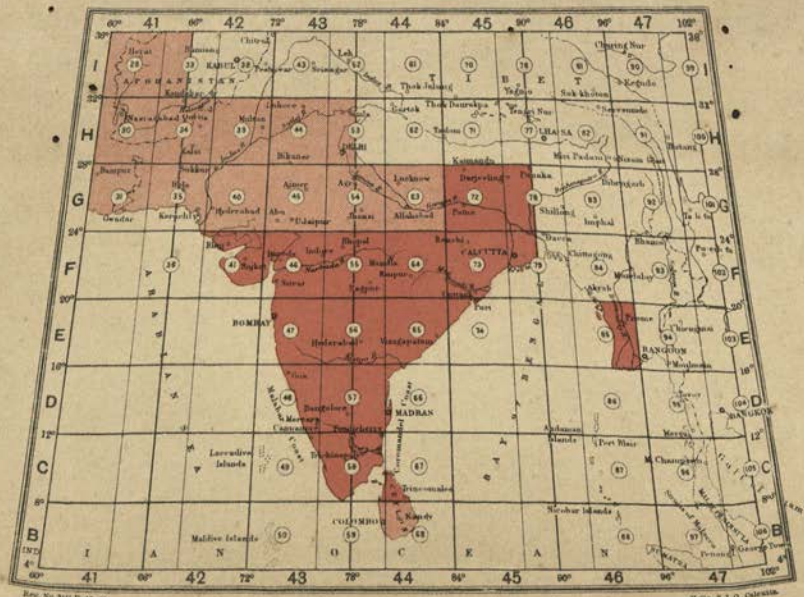
INDIA AND ADJACENT COUNTRIES SERIES

Scale 1 : 1,000,000.

INDEX TO THE SHEETS OF THE

CARTE INTERNATIONALE DU MONDE

on the Scale of 1 : 1,000,000.



Rep. No. 3441 D. 16. 920 Hollo, S. I. O., Calcutta.

EXPLANATION.

The thick lines show the margins of the sheets of the International Map of the World, Scale 1:1,000,000. Each sheet is designated by the letter N (Northern hemisphere), followed by the marginal letter and number corresponding to its position, *e.g.*, the sheet which includes Bombay is N.E.43.

The figures in circles are the numbers of the sheets of the India and Adjacent Countries series on the Scale of 1-1,000,000.

Scale 1:1,000,000.

Miles 100 0 200 300 400 500 Miles

REFERENCE.

Sheets published

" under publication

" in hand

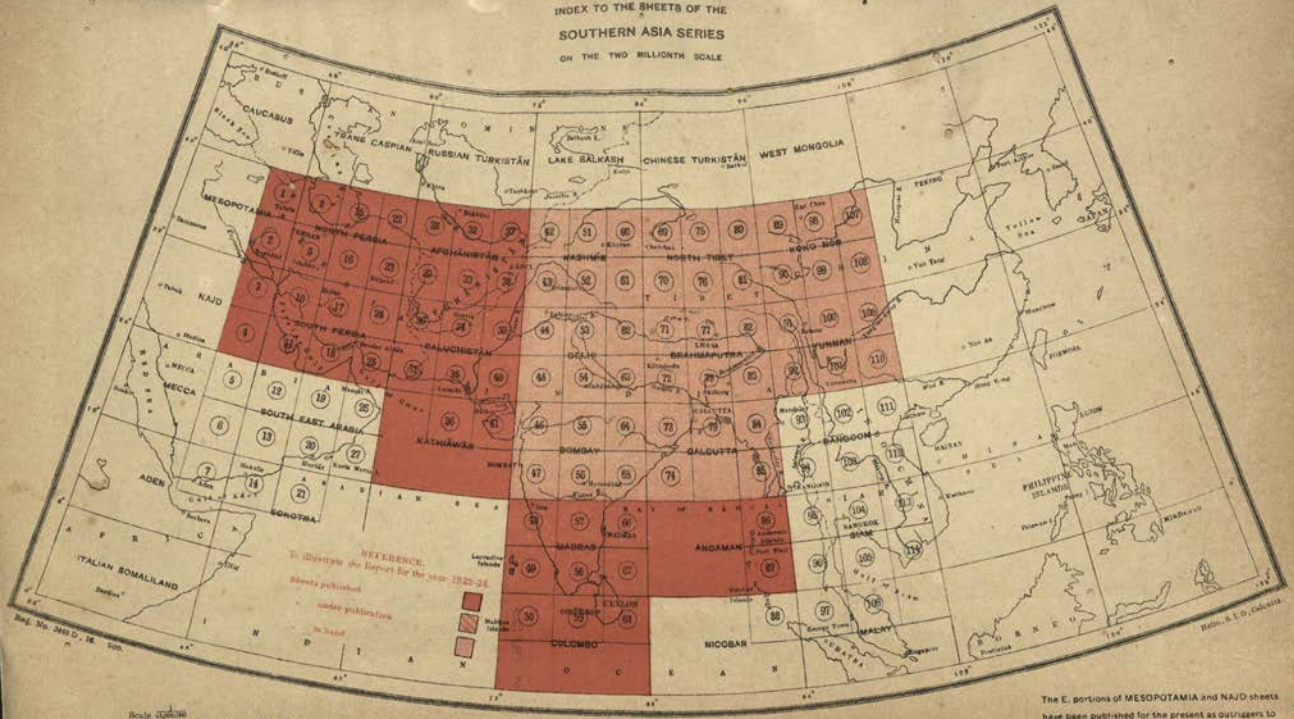
To illustrate the Report for the year 1920-21.

6

INTERNATIONAL SERIES

Scale 1.: 1,000,000.

INDEX TO THE SHEETS OF THE SOUTHERN ASIA SERIES ON THE TWO MILLIONTH SCALE



The E. portions of MESOPOTAMIA and NAJD sheets have been published for the present as outriggers to N. & S. PERSIA sheets respectively.

7

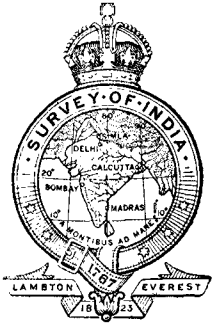
SOUTHERN ASIA SERIES

Scale 1 : 2,000,000.

SURVEY OF INDIA

MAP PUBLICATION AND OFFICE WORK

1924-25



LIBRARY
OF THE
BOMBAY
BRANCH
OF THE

From 1st October 1924
To 31st March 1925.

PUBLISHED BY ORDER OF

Colonel Commandant E. A. TANDY, R.E.,

SURVEYOR GENERAL OF INDIA.

Printed at the Photo.-Litho. Office,
Survey of India,
CALCUTTA,
1926.

NOTICES.

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2.	How to obtain maps and other publications ...	ii
3.	Abstract of Publications other than maps ...	iii
4.	Agents for the Sale of Maps, etc.	iv

HOW WE CAN HELP YOU.

Surveys of every kind can be carried out for private firms as well as for all Government Departments on application to the following Survey Directors :—

The Director, Frontier Circle, Survey of India, Simla. (*Telegrams "Surfrontier"*).

The Director, Northern Circle, Survey of India, Mussoorie. (*Telegrams "Surnorth"*).

The Director, Southern Circle, Survey of India, Bangalore. (*Telegrams "Sursouth"*).

The Director, Eastern Circle, Survey of India, Shillong. (*Telegrams "Sureast"*).

The Director, Burma Circle, Survey of India, Maymyo. (*Telegrams "Surburma"*).

Triangulation, Levelling, Cantonment Surveys, Tide Tables. Advice in regard to these, and on scientific questions, is obtainable from the *Director, Geodetic Branch,* Survey of India, Dehra Dūn, who also undertakes a good deal of levelling and similar work on payment. (*Telegrams "Surtrig"*).

Maps and Illustrations can be printed by the *Director, Map Publication,* Survey of India, 13 Wood Street, Calcutta, for government departments only, and special maps can also sometimes be prepared, on payment. (*Telegrams "Surpub"*).

The Mathematical Instrument Office, Survey of India, 15 Wood Street, Calcutta, supplies and repairs all kinds of optical and surveying instruments, and takes back surplus instruments, on valuation, from all government departments, whether Imperial or Provincial. (*Telegrams "Surinst"*).

General enquiries should be addressed to the Assistant Surveyor General, 13, Wood Street, Calcutta, (*Telegrams "Suroffice"*), as the Surveyor General of India (*Telegrams "Surveys"*) is on tour during most of the year.

HOW TO OBTAIN MAPS AND OTHER SURVEY PUBLICATIONS.

Maps. The Map Record and Issue Office, Survey of India, 13 Wood Street, Calcutta, (*Telegrams "Surmaps"*) can supply maps, on a great variety of scales, for all parts of India and most of Southern Asia. These are also obtainable to some extent, from the Agents detailed on page (iv).

A Catalogue of Maps, showing Survey of India maps available for all Southern Asia, and itself forming a useful atlas of the Indian Empire, is obtainable from the above, at the cost of *One Rupee only.*

Forest Maps are obtainable only from the Forest Map Office, Survey of India, Dehra Dūn. (*Telegrams "Surforest"*).

Geological Maps are obtainable from the Director, Geological Survey of India, Calcutta.

Publications. An abstract of professional publications, other than maps, is given overleaf, and a complete list of these is obtainable *gratis,* from the *Director, Geodetic Branch,* Survey of India, Dehra Dūn. (*Telegrams "Surtrig"*).

ABSTRACT OF PUBLICATIONS.

Survey of India Publications other than maps may be divided into—

(A) Historical and General Reports
(B) Geodetic Works of Reference
(C) Catalogues, Instructional Handbooks, etc.
(D) Miscellaneous Papers.

Historical and General Reports include the Memoirs by Sir Clements Markham and by C. E. D. Black, the Annual General Reports, Narrative Reports, Records Volumes, etc.

Geodetic Works of Reference comprise Everest's Great Arc Books, the G. T. S. Volumes, Triangulation and Levelling Pamphlets, and Tide Tables for various ports between Suez and Singapore.

The G. T. S. Volumes form a series of nineteen volumes, describing in detail the various operations of the Great Trigonometrical Survey. Detailed accounts are given of Base-line measurements, of the reduction of Principal Triangulation with each main figure treated separately, of Telegraphic Longitude and Astronomical Latitude operations and of Levelling of high precision.

Catalogues, Instructional Handbooks, etc., comprise Departmental Orders, Catalogues and Lists, Tables and Star Charts, Manuals, Handbooks, etc.

Miscellaneous Papers include various unclassified papers on Geography, Geodesy, Exploration, etc., and other professional and departmental papers and forms.

A complete catalogue of all the above may be had gratis on application to the Director, Geodetic Branch, Survey of India, Dehra Dūn.

AGENTS FOR THE SALE OF INDIAN OFFICIAL PUBLICATIONS.

London.

A. CONSTABLE & Co., 10, Orange Street, Leicester Square, W.C.

P. S. KING & SON, 2 and 4, Great Smith Street, Westminster, S.W.

KEGAN PAUL, TRENCH, TRÜBNER & Co., 68, Carter Lane, E.C.

B. QUARITCH, 11, Grafton Street, New Bond Street, W.

HENRY S. KING & Co., 65, Cornhill, E.C.

GRINDLAY & Co., 54, Parliament Street, S.W.

T. FISHER UNWIN, LTD., 1, Adelphi Terrace, W.C.

W. THACKER & Co., 2, Creed Lane, Ludgate Hill, E.C.

LUZAC & Co., 46, Great Russell Street, W.C.

Edinburgh.

OLIVER AND BOYD, Tweeddale Court.

Dublin.

E. PONSONBY, LTD., 116, Grafton Street.

Oxford.

B. H. BLACKWELL, 50 and 51, Broad Street.

Cambridge.

DEIGHTON, BELL & Co., LTD., Trinity Street.

ON THE CONTINENT.

ERNEST LEROUX, Rue Bonaparte, Paris - **France.**

MARTINUS NIJHOFF, The Hague - **Holland.**

OTTO HARRASSOWITZ, Leipzig
FRIEDLÄNDER & SOHN, Berlin } **Germany.**

FOR MAPS ONLY.

London.

EDWARD STANFORD, LTD., 12-14, Long Acre, W.C.

SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, (GENERAL DEPARTMENT), 42, Grosvenor Gardens, S.W.1.

India.

DELHI.

OXFORD BOOK AND STATIONERY Co., Kashmir Gate.

SIMLA.

THACKER, SPINK & Co.

CALCUTTA.

THACKER, SPINK & Co., 3 Esplanade, East.

NEWMAN & Co., 3 Old Court House Street.

BOMBAY.

THACKER & Co., LTD.

D. B. TARAPOREVALA SONS & Co.

MADRAS.

HIGGINBOTHAMS, LTD.

RANGOON.

THE CURATOR, GOVERNMENT BOOK DEPÓT, BURMA.

LAHORE.

THE PUNJAB RELIGIOUS BOOK SOCIETY.

PESHÁWAR.

NORTHERN INDIA BOOK DEPÓT.

KASHMÍR.

COCKBURN AGENCY, Srinagar.

MUZAFFARPUR.

BURMAN & Co.

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MAP PUBLICATION REPORT.

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VI.—INDEXES— ... ... At end.

1. Modern Publications, 1-inch and ½-inch scales.

2. „ „ ¼ „ „ ⅛ „ „

3. Index to sheets of the India and Adjacent Countries Series, on the scale of 1:1,000,000 or 1·014 inches to 16 miles.

4. Index to sheets of the Carte Internationale du Monde on the scale of 1:1,000,000.

5. Index to sheets of the Southern Asia Series on the two millionth scale.

MAP PUBLICATION
AND OFFICE WORK

FOR THE HALF YEAR

1st October 1924
to 31st March 1925.

I.—INTRODUCTION AND PERSONNEL.

1. Annual Reports.—Commencing with the present year annual reports are arranged in three main parts as follows:—

- General Report,
  Geodetic Report,
  Map Publication and Office Work Report.

The General Report gives a full description of all ordinary survey operations, and only includes bare abstracts of the Geodetic and Map Publication Reports. It has only one index, illustrating the progress of topographical surveys. The General Report and the Geodetic Report are for the survey year ending 30th of September, whereas the Map Publication Report corresponds with the financial year, which is for several reasons more suitable for these office reports. The Mathematical Instrument Office has always had to make its annual report correspond with the financial year, but with this exception, all the other offices included in the present Map Publication Report have already reported their work up to the 30th of October 1924, and therefore only report for the half year from 1st of October 1924 to 31st of March 1925 in the present volume.

2. The present report.—*The indexes* form the most important part of this report, as they show the progress of publication to date for all our standard series of modern maps, excluding trans-frontier work. Old maps on various scales are available for the whole of India, but some are very old and sketchy. All previous to 1905 were published in old style and based on the longitude determined in 1815, which was about 2 miles out of position, and are therefore excluded from the indexes, though duly shown on our map catalogues.

3. *Letterpress.* Apart from the introduction, and the annual report of the Mathematical Instrument Office at the end of the volume, the present report is divided into three main parts:—

(*a*) Showing all publications and issues of the Department for the half year.

(*b*) Showing all the fair-drawing, whether completed for publication or still in hand, carried out by the various Drawing Offices and field parties.

(*c*) Reports of the work of printing and miscellaneous offices; excluding the Computing and Tidal party, whose work is of a geodetic character and will be published in full in the annual Geodetic Report.

4. Personnel. Owing to this attempt to show the above operations more clearly by grouping them under these three main heads, it has been necessary to ignore in some respects the existing organization of some of the offices. Thus the copper-plate printing section is under the control of the Officer in charge of No. 1 Drawing Office, though, under this system of grouping, its work must obviously be reported as part of our printing operations, and not under the head of Drawing Offices.

For these reasons it is sometimes impossible to show the organization and names of the personnel in the body of the report, and they have therefore all been included in the following list, which also serves to show all the units whose work is included in the present report.

Calcutta. Director Map Publication.—Col. H. Wood, R.E.

Chief Draftsman { Mr. Pramadaranjan Ray, R.S., to 9-1-25.
,, E. B. West from 10-1-25.

Map Record and Issue Office.

Class I Officers.

Lt.-Col. F. F. Hunter, D.S.O., I.A., to 15-1-25.
Captain H. R. C. Meade, I.A., from 16-1-25.

Mathematical Instrument Office.

Mr. S. Woodhouse, in charge.

Works Managers.

Mr. R. C. Malcolm.
,, A. Lacamp.

Photo-Litho. Office.

Class I Officer.

Captain T. M. M. Penney, R.E.

Managers.

Mr. S. Colquhoun.
,, C. F. Oddy.
,, F. R. Vandyke (*Asstt.*).
,, J. Chorlton (*Asstt.*).

No. 1 Drawing Office.

Class I Officers.

Mr. J. Prasad, R.B., in charge up to 9-1-25.
,, P. Ray, R.S., in charge from 10-1-25.

Class II Officers.

Mr. P. Williams up to 22-2-25.
,, Abinash Chunder Bose.
,, C. West up to 28-10-24.
,, E. B. West from 25-10-24 to 9-1-25.
,, Priya Nath Sur
,, Amar Krishna Mitra.
,, Munshi Lal, B.A.
,, H. T. Hughes.
,, Prafulla Chandra Mitra, B.A.
,, Moqimuddin, B.A., from 2-2-25.

Upper Subordinate Service.

1 Officer.

Dehra Dún. Director Geodetic Branch.—Lt.-Col. R. H. Thomas, D.S.O., R.E.

Publication and Stores Office.

Class I Officer.

Captain W. J. Norman, M.C., R.E.

Photo-Zinco Section.

Mr. A. Francis.

Letterpress Section.

Mr. Shyam Narayan, B.Sc.

Stores and Workshops Section.

Upper Subordinate Service.

Mr. K. K. Das, B.A.

No. 2 Drawing Office and Forest Map Office.

Class I Officers.

Major W. E. Perry, M.C., R.E., in charge from 16-10-24.

Lieut. G. H. Osmaston, M.C., R.E.

Class II Officers.

Mr. H. P. D. Morton, in charge to 15-10-24.

Mr. Rama Prasad Ray, B.A.

,, A. B. Hunter.

,, Nanak Chand Puri, B.A., R.S.

Upper Subordinate Service.

3 Officers.

Mussoorie.

Director Northern Circle.—

Lt.-Col. L. C. Thuillier, I.A.

Assistant Director.—

Bt.-Major E. O. Wheeler, M.C., R.E.

No. 3 Drawing Office.

Class I Officer.

Mr. J. A. Freeman, in charge to 18-1-25 and again from 22-2-25.

Class II Officers.

Mr. J. C. C. Lears, to 2-11-24, and again from 13-3-25.

Mr. E. B. West to 15-10-24.

,, L. Williams, M.B.E., in charge from 19-1-25 to 21-2-25.

Mr. A. A. Graham.

Upper Subordinate Service.

2 Officers.

Simla. *No. 6 Drawing Office.*

Director Map Publication.—

Col. H. Wood, R.E.

Class I Officers.

Major L. G. Crosthwait, I.A., in charge till 16-10-24.

Bt.-Major K. Mason, M.C., R.E., in charge from 17-10-24.

SURVEY SECTION.

Class II Officers.

Mr. F. H. Grant.

,, H. H. P. Butterfield.

2 Clerks.

16 Draftsmen.

ARMY SECTION.

Head Draftsman.—Lieut. W. Smith.

3 European Draftsmen.

3 Printers.

8 Pressmen.

Bangalore.

Director Southern Circle.—

Lt.-Col. G. A. Beazeley, D.S.O., R.E.

No. 4 Drawing Office.

Class I Officer.

Mr. J. O'B. Donaghey, in charge.

Class II Officers.

Mr. E. Claudius.

,, F. C. Pilcher.

,, M. S. Ganesa Aiyar.

Upper Subordinate Service.

3 Officers.

Shillong.

Director Eastern Circle.—

Lt.-Col. A. A. McHarg, D.S.O., R.E.

No. 5 Drawing Office.

Class I Officer.

Mr. W. M. Gorman, in charge.

Class II Officers.

Mr. E. J. Biggie.

Capt. J. O'C. Fitzpatrick, to 26-1-25.

Upper Subordinate Service.

1 Officer.

Maymyo.

Director Burma Circle.—

Lt.-Col. E. T. Rich, C.I.E., R.E.

No. 7 Drawing Office.

Class I Officer.

Mr. W. G. Jarbo, in charge.

Upper Subordinate Service.

3 Officers.

Ten-Mile Map Section (No. 12 Party.)

Class I Officer.

Major V. R. Cotter, I.A.

Class II Officers.

Mr. R. C. Hauson.

Captain J. O'C. Fitzpatrick, from 27-1-25.

Upper Subordinate Service.

2 Officers.

II.—PUBLICATIONS AND ISSUES.

5. Publications.—The publications of the Department for the half year are shown in the following 3 tables, of which Table I shows map publications, Table II letterpress publications and Table III an abstract of the publication of modern topographical maps to date.

Table I(*a*).—Maps published at Calcutta.

Class of maps.	Scale.	New Publications.	New Editions and Reprints.	Number of sheets printed.	Value.
					Rs.
GENERAL MAPS.		*Departmental.*			
Maps of India	Various	...	2	3,040	4,560
GEOGRAPHICAL MAPS.					
Map of India	1″=32miles	...	...	...	...
Southern Asia Series ...	1:2,000,000	...	...	...	...
India and Adjacent Countries Series.	1:1,000,000	2	...	1,000	1,500
La Carte Internationale du Monde.	1:1,000,000	...	...	...	...
TOPOGRAPHICAL MAPS.					
Quarter-inch, (Modern) ...	1″=4 miles	22	10	12,800	19,702
Do. (Prely.) ...	1″=4 miles	2	2	2,650	5,831
Do. (Provl.) ...	1″=4 miles	...	2	400	600
Half-inch, (Modern) ...	1″=2 miles	33	8	14,700	43,994
Do. (Prely.) ...	1″=2 miles	...	...	...	...
One-inch, (Modern) ...	1″=1 mile	59	22	31,095	47,994
Do. (Prely.) ...	1″=1 mile	9	1	2,500	3,750
Do. (Provl.) ...	1″=1 mile	1	...	240	360
Old Style sheets	Various	...	15	1,660	2,127
SPECIAL MAPS.					
District Maps	1″=4 miles	...	...	...	...
Administration Report Maps ...	1″=8 miles	...	...	...	...
Provincial Maps	Various	1	1	562	1,338
Plans of Cities and Cantonments	Various	1	...	1,120	3,920
Index Maps	Various	...	78	180,975	17,686
Miscellaneous Maps ...	Various	7	12	23,928	13,983
Total ...	.....	**137**	**153**	**276,670**	**1,67,340**
		Extra-departmental.			
Maps	Various	79	15	47,953	19,867
Plans and Diagrams ...	Various	174	6	28,390	4,532
Illustrations	.....	118	...	54,559	11,229
Miscellaneous	.....	32	16	60,570	5,248
Total ...	.....	**403**	**37**	**191,472**	**40,876**
Grand Total ...	.....	**540**	**190**	**468,142**	**2,08,216**

Table I *(b)*.—Maps published at Dehra Dūn.

Class of maps.	Scale.	New Publications.	Reprints and New Editions.	Number of sheets printed.	Value.
		Departmental.			Rs.
Cantonment Maps	Various	1	9	8,570	17,810
Forest Maps	,,	23	17	2,711	3,761
Miscellaneous	,,	1	2	2,600	610
Total ...	...	**25**	**28**	**13,881**	**22,181**
		Extra-departmental.			
Maps	Various	15	6	9,785	4,692
Plans & diagrams	,,	6	4	26,569	2,035
Charts	4"	345	...	172,500	26,220
Total ...		**366**	**10**	**208,854**	**32,947**
Grand Total ...		**391**	**38**	**222,735**	**55,128**
Various	Various	60	12	12,700	36,800

Notes.

6. *Calcutta.*—Map publication was considerably delayed by the heavy work of surprinting minute meshes for the Army Department on a very large number of maps already published. As these maps were trimmed and also in many cases folded, the surprinting could only be effected in hand-presses and registration was difficult and often imperfect. This work left insufficient hand-presses for ordinary proof work.

7. *Dehra Dūn.*—Ten cantonment and forty forest maps were published during the period under report, and a large amount of extra-departmental work was done. For the Sutlej Valley Irrigation Project of the Punjab Government 345 special contoured spot-level charts were published. These were reproduced in the vandyke section and caused a great increase of work in that section, the out-turn of negatives being 124 in November and the average monthly out-turn being 90 negatives. The correcting of these negatives threw a great deal of work on the zinc correcting section which had some difficulty in keeping up with it.

The out-turn of the litho. machine increased from 29,000 pulls and 16,500 copies printed in October to 65,000 pulls and 37,200 copies printed in March, the out-turn for March being the highest reached during the last three years.

Table II.—Letterpress Publications.

(a) PUBLISHED AT CALCUTTA.

1. Survey of India General Report, 1923-24. Price Rs. 2 or 3s. 6d. (475 copies.)
2. Hand-book of Topography, Chapter VII, Third Edition, 1924. Price Annas 8. (500 copies).
3. Notes on the organisation, Methods and Processes of the Photo.-Litho. Office. Calcutta, Third Edition, 1924. (350 copies).
4. Catalogue of maps published by the Survey of India, 1924. Price Re 1. (Printed by Litho.). (3,000 copies).
5. Catalogue of maps of Burma, 1925. Price Annas 8. (750 copies).
6. Office Manual (Map Record & Issue Office), 2nd Edition, 1924. (100 copies).
7. Correction to the Hand-book of Topography, Chapter I, No. 27. (750 copies).
8. Corrections to the Hand-book of Topography, Chapter VI, Nos. 129, 130, 131, 132, 133, 139, 140, 143 & 147. (650 copies each).
9. Correction to the Hand-book of Topography, Chapter X, No. 18. (600 copies).

(b) In hand at Calcutta.

1. *Hand-book of Topography, Chapter V.*
2. *Hand-book of Topography, Chapter VIII.*
3. *Hand-book of Topography, Chapter XI.*
4. *Correction to the Hand-book of Topography, Chapter I.*
5. *Appendix XI to Hand-book of Topography, Chapter VI.*

(c) PUBLISHED AT DEHRA DŪN.

1. Tide-tables for 1926 for the 14 ports included in the Admiralty tide-tables. (13,230 copies).
2. New data for levelling pamphlets 57, 47 and 66. (550 copies).
3. Eight Triangulation pamphlets. (800 copies).

(d) In Hand at Dehra Dūn.

1. *Records of the Survey of India, (Magnetic Survey).*
2. *Tidal Chapter of the Hand-book of Trigonometrical Instructions.*
3. *Levelling pamphlet 44.*
4. *Hand-book of Topography, Chapter IX.*
5. *Report on Irrawaddy Delta Air Survey by Major Lewis.*
6. *Bhutān and Tibet Survey (Captain Meade).*
7. *Synopsis of Cantonment Surveys.*
8. *Forest Map Office Record Book.*
9. *Corrections to Routes in Western Himālaya. Vol. I.*

Table III.—Publication of Modern Topographical Maps.

Years of Publication.	NUMBER OF SHEETS PUBLISHED.		
	One-inch Sheets.	Half-inch Sheets.	"Degree" Sheets.
1924-25 (Half-year)	59	33	6
Previous years	2,098	507	119
Total published ...	**2,157**	**540**	**125**
Number of Sheets in India ...	**6,218**	**1,630**	**450**

8. Map Issues.—The following tables show the number of maps issued during the half-year.

Table IV *(a)*.—Map Issues, Calcutta.

	On Book Transfer (to Government Officials).		On Cash Payment.		Free Issues.		TOTAL.	
	Number of Copies.	Value Rs.	Number of Copies.	Value Rs.	Number of Copies.	Value Rs.	**Number of Copies.**	**Value Rs.**
Departmental.	110,278	1,11,794	39,898	54,542	25,924	36,595	176,100	2,02,931
Extra-departmental.	174,989	40,328	23,325	8,270	6,720	940	205,034	49,538
Total ...	**285,267**	**1,52,122**	**63,223**	**62,812**	**32,644**	**37,535**	**381,134**	**2,52,469**

Table IV *(b)*.—Map Issues, Dehra Dun & Circles.

Branch or Circle.	On Book Transfer (to Government Officials).		On Cash Payment.		Free Issues.		TOTAL.	
	Number of Copies.	Value Rs.	Number of Copies.	Value Rs.	Number of Copies.	Value Rs.	**Number of Copies.**	**Value Rs.**
Dehra Dūn (F. M. O.)	1,616	2,341	538	1,174	1,868	4,905	4,022	8,420
Northern Circle	.....	.....	14	26	.....	.....	14	26
Southern Circle	.....	.....	1,675	3,238	.....	.....	1,675	3,238
Total ...	**1,616**	**2,341**	**2,227**	**4,438**	**1,868**	**4,905**	**5,711**	**11,684**

9. Map Record and Issue Office, Calcutta.—During the half-year ending 31st March 1925, sales both to the public and to Government Officials again showed a steady increase.

The re-organization of the record room continued; up to date, the steel fire-proof rack construction completed and in hand was:—

Map Record Section.—5,230 fixed racks constructed and 1,344 in hand, against 5,810 modern maps published to date.

Original Section.—560 almirahs under construction with shelves on rollers, accommodating altogether 6,720 fair originals, against 5,212 modern fair originals received to date for storage.

III.—WORK OF DRAWING OFFICES.

10. Tables V, VI & VII give an abstract of new maps completed for publication and in hand during the half year, for the whole department. These are followed by general remarks about certain offices, which show such additional work as preparing old maps for reprints, correcting office copies, etc.

Table V.—Topographical Maps.

	2-inch.		1-inch.		½-inch.		¼-inch. Political.		⅛-inch.	
No. 1 Drawing Office ...	...	...	...	*34**	2†	*4†*	...	*1* / *3**	...	...
No. 2 Drawing Office ...	...	...	...	...	1	...	1	*7*	...	*5*
No. 6 Drawing Office ...	...	...	...	...	2	*1*	8	*14*	...	...
No. 3 Drawing Office ...	...	...	...	*5*	9	*8*	1	*7*	...	...
Northern Circle Parties...	...	...	4	...	2	*3*	...	...	...	...
No. 4 Drawing Office ...	...	...	...		4	*8*	1	...	...	...
Southern Circle Parties...	8	*1*	56	*1*	11	*2*	...	...	...	...
No. 5 Drawing Office ...	...	...	...	*1*	...	7	...	*3*	...	...
Eastern Circle Parties ...	12§	...	14	...	6	*5*	...	...	...	...
No. 7 Drawing Office ...	...	...	...	...	2	*5*	...	*4*	...	...
Burma Circle Parties‡...	48	*1*	21	*2*	2	...	...	...	...	...
TOTAL ...	68	*2*	95	*31*	41	*43*	11	*39*	...	*5*
Total to date ...	.....		2,193		548		130			
Total for India ...	.....		6,218		1,630		450			

NOTE.—Figures in italics denote work in hand.
* Preliminary editions.
† Provisional issues.
‡ Figures against this in column '2-inch' include '3-inch' and '4-inch'.
§ 4-inch.

Table VI.—Geographical maps on the 1/M and 1/2M scales.

Map.	No. 1 Drawing Office.		No. 2 Drawing Office.		No. 6 Drawing Office.		Total.		Total. to date.	Total for Southern Asia.
1/2 M	...	*11*	1	*1*	...	...	1	*12*	.....	9
1 M political and layered	1	...	1	*2**	...	*2*	2	*4*	71	.....
„ engraved ...	...	*16*	...	...	...	...	...	*16*		
„ Carte Internationale	5	*10*	...	...	...	...	5	*10*	13	.....

NOTE.—Figures in italics denote work in hand.
* Of these one had been previously sent for publication and was returned for the insertion of fresh work, the result of recent exploration.

Table VII.—General and Special Maps.

Map.	Scale.	Completed for publication.	In hand.
No. 1 Drawing Office.			
Railway map of India	1:4,250,000	...	1
India and Adjacent Countries ...	1 inch = 128 miles	...	1
,, ...	1/4 M	...	1
,, ...	1 inch = 64 miles	...	1
,, ...	1 inch = 50 ,,	...	1
Hill shading sheets	Various	45	9
Minute mesh originals	Various	208	...
Calcutta guide map	6 inches = 1 mile	...	4
Miscellaneous maps	Various	18	...
No. 2 Drawing Office.			
Triangulation charts	1 inch = 4 miles	7	8
Levelling chart	1 inch = 16 miles	1	
Sutlej Valley Level charts	4 inches = 1 mile	195	146
Minute mesh originals (Aden). ...	1 inch = 2 miles	10	...
Cantonment plans, new surveys from No. 20 Party prepared for publication.	Various, 12 inches to 64 inches = 1 mile.	49	11
Miscellaneous maps and charts ...	Various	50	1
Forest Map Office.			
Forest editions of 1-inch maps ...	2 inches = 1 mile	3	18
Working plan maps	Various	5	1
Miscellaneous maps and diagrams ...	,,	27	58
No. 3 Drawing Office.			
Special map	4 inches = 1 mile	5	...
"Allahābād and Environs" ...	6 inches = 1 mile	...	2
Hill shading sheets	Various	30	...
Northern Circle Parties.			
"Āgra and Environs"	6 inches = 1 mile	2	...
No. 4 Drawing Office.			
Hill shading sheets	Various	29	19
No. 5 Drawing Office.			
Assam Province map	1 inch = 32 miles	1	...
Guide map of Shillong	6 inches = 1 mile	...	1
(No. 12 Party) 10-mile Mapping Section.			
Ten-mile Guide maps	1 inch = 10 miles	0	9
No. 6 Drawing Office.			
Miscellaneous maps and plans ...	Various	181	...
Special map	1 inch = 1 mile	...	1
Guide map of Simla	8 inches = 1 mile	...	1
No. 7 Drawing Office.		*Nil.*	*Nil.*

New Editions and Miscellaneous Work.

11. No. 1 Drawing Office.—In addition to the work shown in Tables V to VII, the following work was carried out :—

(*a*) *Reprints.* Sheets corrected and brought up to date for reprint :—

	Completed.	In hand.
Carte Internationale 1/M	4	3
Southern Asia Series 1/2M	.....	1
India and Adjacent Countries 1/M		
Engraved Editions	2	4
Helio. Editions	3	3
One-inch sheets, old style (15′ × 30′) ...	16	8
„ „ modern	57	9
Half-inch sheets	8	2
Quarter-inch sheets, provisional	2	7
„ „ „ modern	5	1
Indian Atlas sheets	.....	2

(*b*) *Miscellaneous work.*

The originals of 75 sheets were corrected against press order proofs.

Mosaics for 16 sheets.

Additions and corrections entered on office copies of 1,397 sheets, 171 "office copies" of newly published or reprinted sheets prepared.

Areas of 96 newly published sheets checked and entered in the area register.

12. No. 2 Drawing Office.—In addition to the work shown in Tables V to VII, the following work was carried out :—

	Completed.	In hand.
M. E. S. corrections incorporated in Cantonment plans.	66	126
Cantonment plans corrected for reprint ...	16	22
Aden sheets, 1 inch=2 miles, prepared for reprint	6	.....
Colour guides prepared for Cantonment and other maps.	127	12

Special compilations of 1/M sheets 107 and 108 for 1/2M Koko Nor sheet have been completed and similar compilations of 1/M sheets 109 and 110 are in hand for the 1/2M Yunnan sheet. It is not proposed to publish any of the above in the 1/M series at present.

Contour charts on scale four inches to one mile of the Sutlej Valley Irrigation Scheme area (Punjab) have been prepared by the insertion (in office) of contours at 1 foot vertical interval on spot height charts submitted by No. 17 Levelling Party. As the ground had not been previously surveyed on the 4-inch scale, this contouring could not be done on maps of the area and so is very approximate only. Portions

of the area have now however been surveyed during the cold weather of 1924-25 and during the ensuing year the sheets of these areas will be recontoured (in office) on the detail survey and fresh editions of the charts will be published showing detail and contours.

The section dealing with the preparation of the contour charts has been chiefly composed of pieceworkers specially engaged for the work: this has been found a very satisfactory arrangement.

13. *Forest Map Office.*—The following work has been carried out in addition to that shown in Table VII:—

Maps prepared for reprint	8
Office copies of maps prepared	53
Office copies corrected from notifications	156
Sheets coloured for indents and office copies	282
Sheets mounted for indents and office copies	887
Forest information entered on maps for other Survey offices	71

Eight Forest maps of Indian States drawn by parties of the Southern Circle were received for publication and are awaiting acceptance of estimates before final printing.

The printing of a list of forest triangulation and traverse data and of the revised Catalogue of Forest maps is still in hand. The latter is being printed by the Government of India, Central Publication Branch, Calcutta; this is nearing completion and a few advance copies have been received.

The Government of Assam decided to make their own arrangements for drawing, publication and storage of forest maps from 1st April 1925; all forest records and maps relating to the Province have therefore been despatched to the Director of Surveys, Assam.

Since December 1924 the supervising staff has been reduced to two Class II officers only.

14. No 3. Drawing Office.—In addition to the work shown in Tables V and VII, the following work was carried out:—

	Completed.	In hand.
Hill shaded originals on 1", ½" and ¼" scales ...	15	.....
Colour patterns and press order proofs ...	30	12
Office copies corrected for reprint	42	.....
Compilation of Topo. triangulation falling in Degree sheets.	3	5

There are 18 half-inch areas of which the component two-inch and one-inch sheets though surveyed, have not been published. The materials for these areas will shortly be available for fair-mapping.

There are 10 quarter-inch sheets areas of which the component one-inch and half-inch sheets, though surveyed, have not been published.

15. No. 4 Drawing Office.—In addition to the work shown in Tables V and VII, the following work was done:—

The preparation of triangulation pamphlets in draft form is in hand for 8 sheets.

The revision of the register of triangulation and traverse records is in hand. Also photo-zinco work as shown in para. 23.

16. No. 5 Drawing Office.—The six-inch Guide map of Shillong, shown in table VII, takes the place of the old partly drawn four-inch of last year which had to be rejected for various reasons; the map should be ready for publication in the near future.

A pupil surveyor class was started and instruction given in drawing and hand printing.

17. No. 12 Party.—*Ten-mile Mapping Section.* This section has been formed to experiment with a proposed new series of maps on the scale of 10 miles to one inch. The series is based on local enquiries where no recent surveys are available, and aims at giving up-to-date information for the use of air-craft and motorists, as well as for general use.

The compilation of 21 maps was started, 9 of which, *viz*:—TEZPUR, SYLHET, SHILLONG, CHITTAGONG, BANKIPORE, GAYĀ, CALCUTTA, KRISHNAGAR and PURNEA, were well advanced by the end of September 1925.

18. No. 6 Drawing Office (*Simla*).—In addition to the work in Tables V, VI and VII, the following work was also carried out:—

1. Examination of proofs and preparation of colour guides.

	Examined.	In hand.
1/M sheets	3	.....
½" „	1	.....
¼" „	11	1

2. Rough compilations for 8 quarter-inch sheets were prepared *and the compilations of 4 quarter-inch sheets begun.*
3. Corrections on 6 half-inch sheets and 3 quarter-inch sheets were carried out and the sheets sent for publication.
4. A map of Nepāl on a scale of 1 inch = 8 miles was compiled from material supplied by Mr. Percival Landon and the compilation sent to him on completion.

The Survey Section has been employed on the compilation and fair-drawing of trans-frontier maps on the one-millionth, half-inch and quarter-inch scales.

The Army Section is employed on the preparation and printing of maps and plans for the Army and other Government Departments.

During the six months ending on the 31st March, 181 maps and plans were dealt with and 24,368 copies were printed from the presses.

Courses in map drawing and topography were held throughout the period, 6 non-commissioned officers being instructed and passed by Lieutenant Smith during the period.

19. No. 7 Drawing Office.—In addition to the work shown in Table V, the following work was carried out :—

6 Survey sheets of the Yenangyaung Oil Field, scale 24 inches = 1 mile, each sheet 28″×40″.

3 sheets for an engineering edition without contours and

3 sheets for a geological edition with 10-foot spirit levelled contours are also in hand.

IV.—PRINTING AND MISCELLANEOUS.

20. The Photo.-Litho. Office, Calcutta. The following table shows the cost and out-turn of the Photo.-Litho. Office. Apart from the photo.-lithographic work of the office, the Photo. branch produces halftone, three-colour and line blocks, and photogravure plates, while the out-turn of the type letter-press printing section of the Litho. branch averages many lakhs of pulls a year. A summary of the out-turn of these classes of work is shown below.

The minute mesh required on maps for military purposes has had to be surprinted on to many thousands of stock copies. The employment on this work of several hand presses, which would otherwise have been available for normal work, has thrown a considerable strain on the office.

In the Cost and Out-turn Table given below, the figures in the first two columns are not directly comparable with those given in similar tables in previous reports. Those in the present table will afford, when compared with future ones, a truer comparison of the financial working of the office. The "expenditure" now includes the cost of stores received from England, which was omitted in earlier reports, and the "office rates" are based on a revised scale, which takes into account all overhead charges, including such capital items as value of plant, office furniture, etc., in addition to the actual working expenditure.

COST AND OUT-TURN OF PHOTO.-LITHO. OFFICE.

Expenditure.	Value of out-turn at office rates.	Negatives prepared.	Zinc plates prepared.	Maps printed.		Impressions pulled.
				Departmental.	Extra-departmental.	
Rs.	Rs.					
1,80,877	2,21,062	3,151	3,757	526	1,320	1,607,096

INDEPENDENT OUT-TURN OF PHOTO. BRANCH AND TYPE LETTER-PRESS PRINTING SECTION.

Photo. Branch.					Type letter-press printing section.		
Half-tone Work.		Line Work.		Photo-gravures.			
Blocks prepared.	Impressions pulled.	Blocks prepared.	Impressions pulled.	Plates prepared.	Items or pages published.	Copies printed.	Impressions pulled.
309	80,466	34	46,866	8	1,257	425,714	899,995

21. The Engraving Office, Calcutta. This office is under the charge of No. 1 Drawing Office. The out-turn of its copper-plate printing section was 6,950 impressions, which includes both departmental work (77°/₀) and extra-departmental work (23°/₀). Of the departmental work 33°/₀ consisted of scales, 35°/₀ miscellaneous, which included art paper prints, transfers, etc., and 32°/₀ photogravure impressions from plates prepared by the Photo.-Litho. Office.

22. The Publication and Stores Office, Dehra Dun. This office was organized as a separate unit in 1922, but it has not been mentioned in previous reports. It consists of the Photo-Zinco Section, Printing Section and the Stores and Workshop Section.

Photo-Zinco Section deals with the publication of cantonment maps, index and triangulation charts, forest maps, and some miscellaneous and extra-departmental maps. Though very few forest maps were received for reproduction during the six months under report, the section was fully occupied reproducing the Sutlej valley level charts. The following table shows the out-turn of this section since its reorganization.

Years.	No. of Subjects.	No. of Negatives.	No. of Pulls.	No. of Chocolate and Bromide prints.
1922-23 ...	1,719	1,580	318,229	1,193
1923-24 ...	1,270	1,680	374,954	55
1924-25 (6 months). ...	**1,208**	**692**	**299,249**	*Nil.*

Letterpress Printing Section. For publications *vide* Table II(*c*) and II(*d*), page 6.

The Stores and Workshops Section maintains all technical and camp stores of the Geodetic Branch, makes local purchases for all sections of Geodetic Branch Offices and superintends the maintenance and erection of buildings. During the half year under report a new transit observatory has been built to accommodate 2 reversible transit instruments.

23. No. 4 Drawing Office, Bangalore. The Vandyke press did the following photo-zinco work:—

Number of reproductions	58
.. .. enlargements	25
.. .. reductions	324
.. .. vandyked plates prepared	174
.. .. prints pulled	4,804

V.—MATHEMATICAL INSTRUMENT OFFICE.

24. The report in this case is for the whole year from 1st April 1924 to 31st March 1925. During this period there was a slight decrease in the demands on this office for supply of instruments, compared with the previous year, the value of work done in the workshop being nearly the same as last year (*vide* items 1 and 6 in the statement below). The workshop made an appreciable profit of Rs. 46,607 against Rs. 43,313 in 1923-24, and the store Rs. 10,878 against Rs. 26,348 in 1923-24.

25. The following statement shows the figures for the last 3 years:—

	1922-23.	1923-24.	1924-25.
	Rs.	*Rs.*	**Rs.**
1. Total value of stores issued to Public Offices as shown in the Profit and Loss statements.	6,25,953	4,46,559	**3,75,024**
2. Value of repairs to instruments received from Public Offices for repairs, and returned in serviceable condition.	1,70,010	1,56,682	**1,28,931**
3. Value of instruments received from Government Offices as no longer required.	83,933	54,824	**51,875**
4. Book value of the stock of instruments, &c., in Serviceable Store.	5,75,844	5,14,985	**3,25,685**
5. Book value of the stock of instruments, &c., in Repairable Store.	1,26,616	1,11,113	**1,04,859**
6. Total value of work done in the Workshop	4,89,329	3,92,672	**3,82,467**
7. Value of instruments manufactured in the Workshop for Serviceable Store.	1,68,588	1,14,677	**1,42,616**
8. Value of instruments purchased locally	22,840	13,034	**35,356**
9. Value of instruments and materials obtained from England through the Director General, India Store Department.	2,20,650	1,47,733	**95,750**
10. Average No. of employees and their pay including pension contribution.	No. 554 Rs. 1,88,009	No. 402 Rs. 1,57,280	**No. 386** **Rs. 1,52,166**

26. During the year the stocks of the Serviceable, Repairable and Material Stores were taken twice as usual and the discrepancies found were duly adjusted. Surplus and obsolescent stock articles to the value of Rs. 10,870 were disposed of to the best advantage of Government.

27. Various improvements have been made in the Workshop methods and systems and a number of experiments carried out in connection with special apparatus. In the glass blowing department which has been instituted for the repair and manufacture of spirit bubbles, thermometers, barometer-tubes and other scientific glass apparatus, two special maximum thermometers were designed and manufactured for the Tropical School of Medicine in connection with autoclave experiments and have proved satisfactory. Two experimental museum microscopes were also developed and manufactured for the Tropical School of Medicine and have

been favourably reported upon in their annual report. Further experiments are being made to provide increased magnification and to adapt these instruments for optical projection purposes.

An improved pattern of binocular collimator, and improvements in the design of map enlarging and reducing cameras made in the office proved very satisfactory. In connection with the manufacture of ranging poles, a new apparatus was devised which made a considerable reduction in the manufacturing cost, also a recently introduced system of recording the rates of chronometers under repair, which are now graphically delineated has proved very instructive in regard to their variation.

Very encouraging results have also been obtained in barometer repair work by means of an electrical apparatus designed and manufactured in the office to overcome inherent difficulties experienced by Home manufacturers and in India, in the production of a good Torricellian vacuum in these instruments.

The machine department was reorganised with a view to centralisation, expeditious manufacture, and more detailed supervision, and in accordance with the Retrenchment Committee Report, a large number of stores were surveyed and obsolete patterns deleted from stock; in addition to the above, stock-taking methods were altered to facilitate early balancing of the store ledgers. Mr. Campbell, Director General of Commercial Audit, who visited the office in connection with the Mathematical Instrument Office accounts, was very favourably impressed with the efficiency of the stock-taking, planning and costing methods now employed in the works.

During the past year the manufacture and renovation of repairable instruments, principally theodolites and levels, for the Serviceable Store has been considerably increased. In the workshop the numbers of theodolites and levels repaired were 206 and 367 respectively, and 92 theodolites and 107 levels were cleaned and adjusted.

The output of repaired prismatic binoculars maintains the increasing ratio of former years, over 2,560 being repaired for the military, which is the highest annual figure yet reached. The manufacture of band chains has been inaugurated in the works, and in this connection a standard invar band chain has been erected for comparison purposes. 30,000 ft. of supernumerary metre band chains are being altered to feet and yards measurement of which 164—100 ft. bands have been completed and issued.

The total number of microscopes renovated was 32.

The number of officers dealt with during the year in regard to supplies, inclusive of all services, totals 1,744.

SURVEY OF INDIA

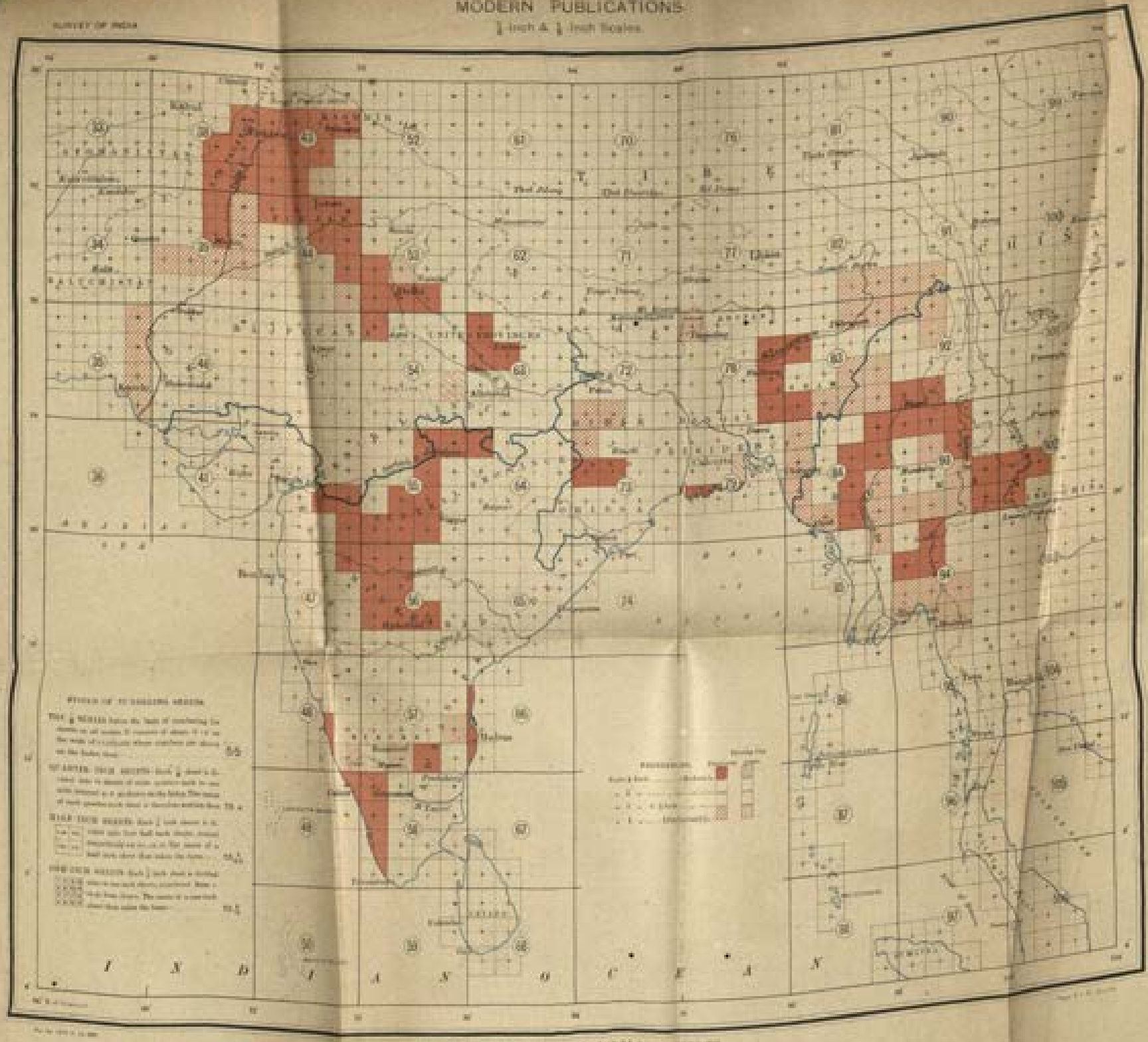
MODERN PUBLICATIONS.

1-inch & ½ inch Scales

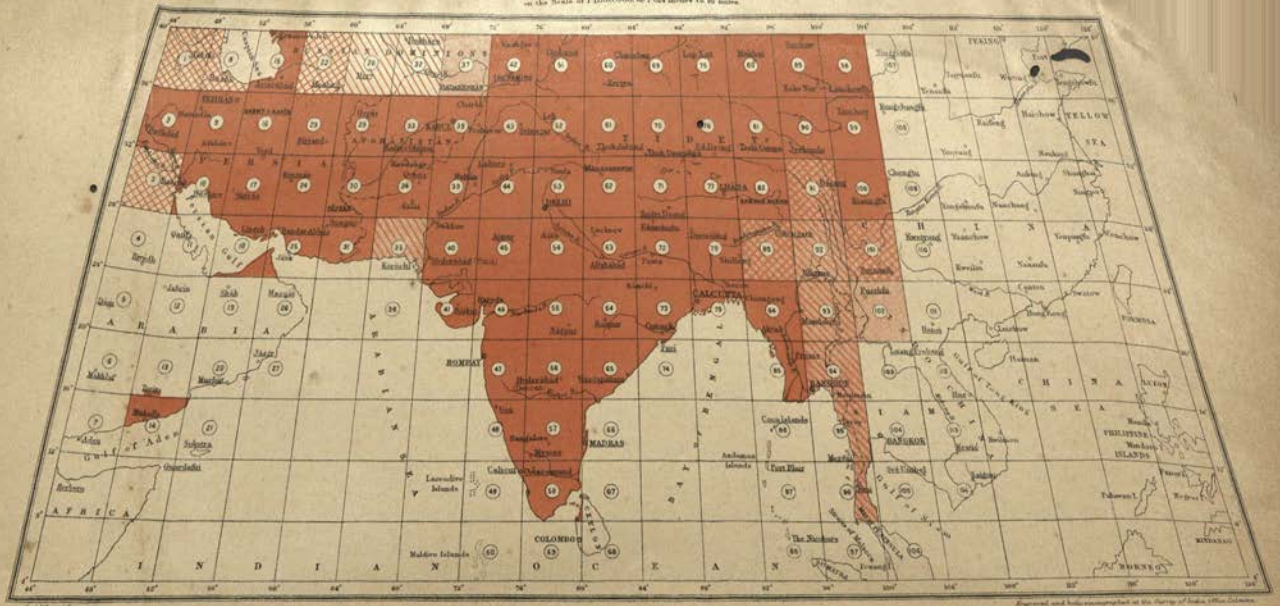
SURVEY OF INDIA

MODERN PUBLICATIONS

½ Inch & ¼ Inch Scales



on the Scale of 1/1,000,000, or 1·014 inches to 16 miles.



Ref. W. 1733 D. 20. 800

Engraved and Printed under the Superintendent at the Survey of India, Office Calcutta.

NOTE.

The names underlined on this Index are the title names of the sheets, and their numbers are shown in circles. Sheets 25 and 26, 37 and 66, are published respectively as combined sheets.

Scale 1/1,000,000.

Miles 100 0 100 200 300 400 500 Miles

3

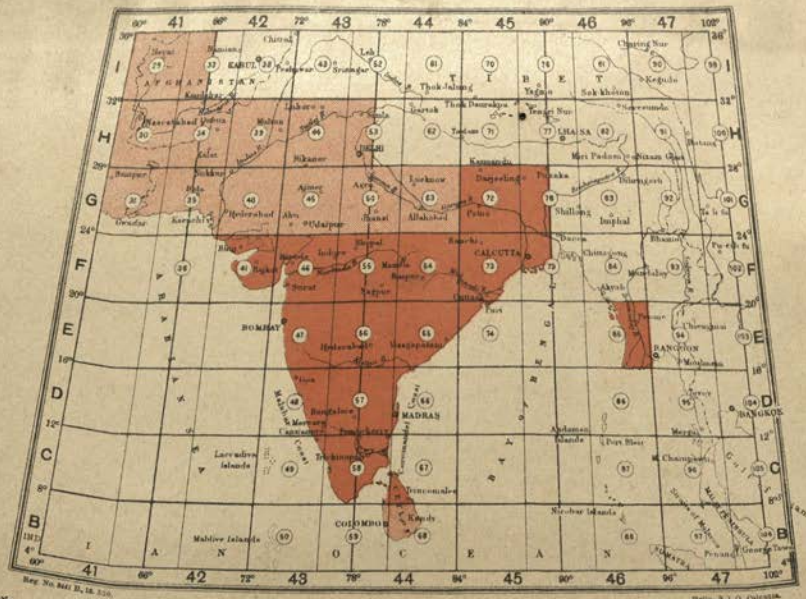
INDIA AND ADJACENT COUNTRIES SERIES

Scale 1 : 1,000,000.

INDEX TO THE SHEETS OF THE

CARTE INTERNATIONALE DU MONDE

on the Scale of 1:1,000,000.



EXPLANATION.

The thick lines show the margins of the sheets of the International Map of the World, Scale 1:1,000,000. Each sheet is designated by the letter N (Northern hemisphere), followed by the marginal letter and number corresponding to its position, *e.g.*, the sheet which includes Bombay is N.E.43.

The figures in circles are the numbers of the sheets of the India and Adjacent Countries Series on the Scale of 1:1,000,000.

REFERENCE.

Sheets published

" under publication

" in hand

To illustrate the Report for the year 1924-25.

Reg. No. 8421 B. (S. 3.)

Hellio, S. I. O., Calcutta.

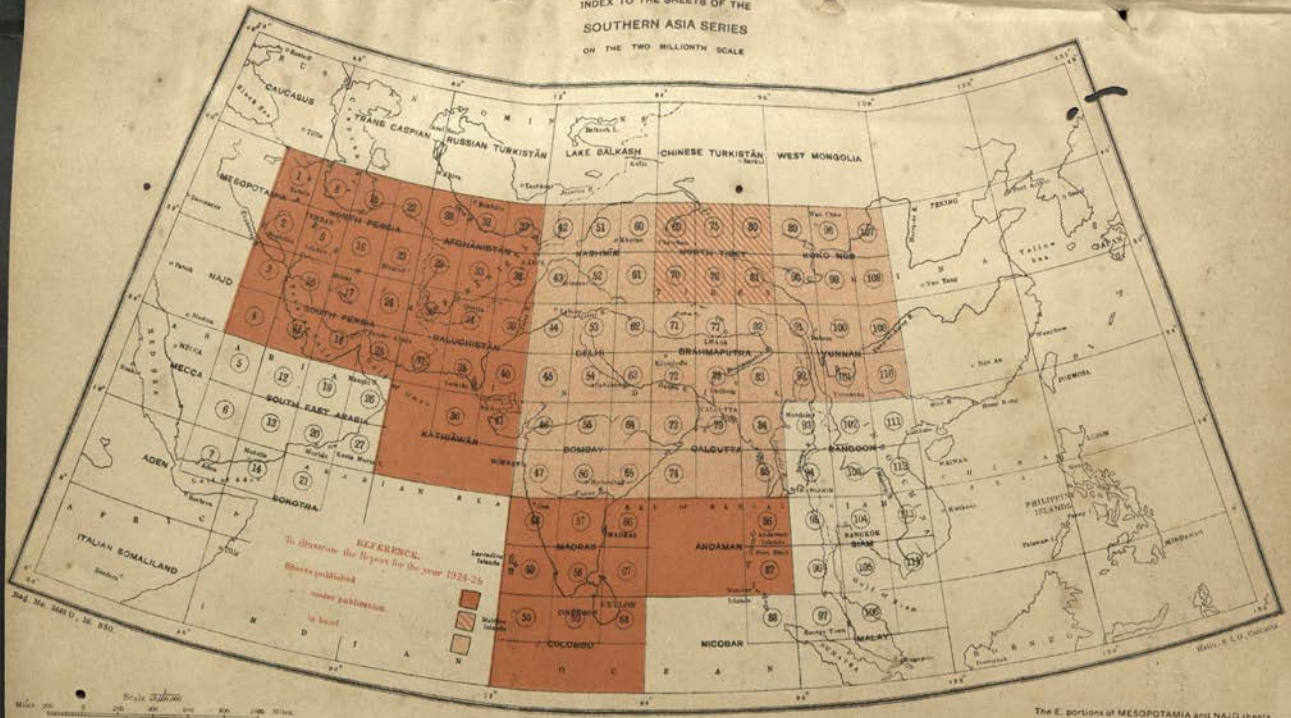
4

INTERNATIONAL SERIES

Scale 1 : 1,000,000.

INDEX TO THE SHEETS OF THE SOUTHERN ASIA SERIES

ON THE TWO MILLIONTH SCALE



The E. portions of MESOPOTAMIA and NAJD sheets have been published for the present as outriggers to N. & S. PERSIA sheets respectively.

5

SOUTHERN ASIA SERIES

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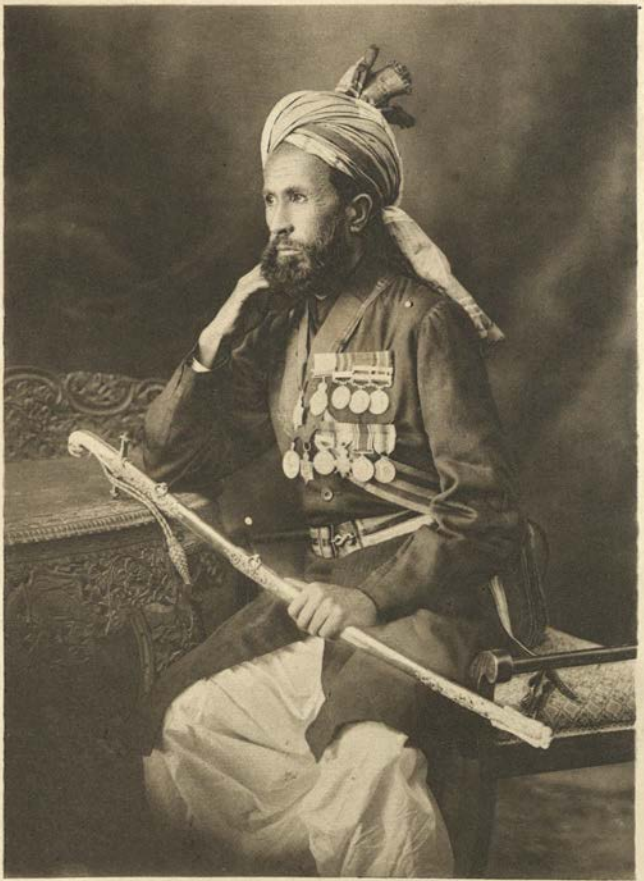

Photogravure. Survey of India Offices, Calcutta, 1925.

KHAN BAHADUR SHER JANG

SURVEY OF INDIA

GENERAL REPORT

1924 TO 1925

From 1st October 1924
To 30th September 1925

PUBLISHED BY ORDER OF

Colonel Commandant E. A. TANDY, R.E.,

SURVEYOR GENERAL OF INDIA.

Printed at the Photo.-Litho. Office,
Survey of India,
CALCUTTA,
1926.

LIBRARY OF THE BOMBAY BRANCH OF THE ROYAL ASIATIC SOCIETY

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HOW WE CAN HELP YOU.

Surveys of every kind can be carried out for private firms as well as for all Government Departments on application to the following Survey Directors:—

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Triangulation, Levelling, Cantonment Surveys, Tide Tables. Advice in regard to these, and on scientific questions, is obtainable from the *Director, Geodetic Branch,* Survey of India, Dehra Dūn, who also undertakes a good deal of levelling and similar work on payment. (*Telegrams "Surtrig"*).

Maps and Illustrations can be printed by the *Director, Map Publication,* Survey of India, 13 Wood Street, Calcutta, for government departments only, and special maps can also sometimes be prepared, on payment. (*Telegrams "Surpub"*).

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HOW TO OBTAIN MAPS AND OTHER SURVEY PUBLICATIONS.

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A Catalogue of Maps, showing Survey of India maps available for all Southern Asia, and itself forming a useful atlas of the Indian Empire, is obtainable from the above, at the cost of *One Rupee only.*

Forest Maps are obtainable only from the Forest Map Office, Survey of India, Dehra Dūn. (*Telegrams "Surforest"*).

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ABSTRACT OF PUBLICATIONS.

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(A) Historical and General Reports
(B) Geodetic Works of Reference
(C) Catalogues, Instructional Handbooks, etc.
(D) Miscellaneous Papers.

Historical and General Reports include the Memoirs by Sir Clements Markham and by C. E. D. Black, the Annual General Reports, Narrative Reports, Records Volumes, etc.

Geodetic Works of Reference comprise Everest's Great Arc Books, the G. T. S. Volumes, Triangulation and Levelling Pamphlets, and Tide Tables for various ports between Suez and Singapore.

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Catalogues, Instructional Handbooks, etc., comprise Departmental Orders, Catalogues and Lists, Tables and Star Charts, Manuals, Handbooks, etc.

Miscellaneous Papers include various unclassified papers on Geography, Geodesy, Exploration, etc., and other professional and departmental papers and forms.

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SURVEY OF INDIA

GENERAL REPORT

1924 TO 1925

From 1st October 1924
To 30th September 1925

INTRODUCTION AND SUMMARY.

1. Annual Reports.—Commencing from the present year, Annual Reports are published in three separate volumes as follows:—

General Report.
Geodetic Report.
Map Publication and Office Work Report.

The first two are for the survey year ending 30th September but the last is for the financial year up to 31st March.

The Map Publication Report contains *all the Index maps* showing the progress of map publication on all scales, with reports on publication and issue, printing and drawing, and of such offices as the Mathematical Instrument Office, which have to conform with the financial year.

The Geodetic Report includes full details of all scientific work.

This General Report therefore only gives brief abstracts of the above, (*vide* Abstracts IV and V in the Table of Contents on opposite page) and is confined to reporting the survey operations of the ordinary field parties and detachments. The first three Abstracts (*vide* Table of Contents) summarise these reports and enable the reader to look up such portions as may concern him. There is only one *Index map*, at the end, showing the progress of modern topographical surveys and compilation. Maps of sorts are of course available for all parts of the Indian Empire, but some are very old, and all previous to 1905 were based on the old longitude of 1815, (which was over 2 miles out), and are excluded from the Index map.

2. General. Colonel Commandant E. A. Tandy, R.E., filled the post of Surveyor General throughout the survey year under report. The total area of new surveys of all kinds was 44,317 square miles, which is nearly equal to the total area of England.

3. *The total cost* of the Department for the past financial year ending 31st March 1925, as compared with that of previous years, was as follows:—

	1922-23.	1923-24.	1924-25.	REMARKS.
	Rs.	*Rs.*	*Rs.*	
Gross actual cost ...	54,30,867	51,14,799	53,07,436*	* These figures are not final.
Deduct receipts and credits	25,20,447	21,15,470	22,37,299*	
Net actual charges ...	29,10,420	29,99,329	30,70,137*	

4. *Policy.*—The Department is steadily developing the policy of arranging for all possible co-operation with the local surveys carried out by Provinces and States, and in connection with engineering projects, &c. The demands for assistance or co-operation in these respects are growing rapidly and are putting our resources to a very considerable strain; but there is no doubt that this policy saves much waste and reduplication of work, which would otherwise arise from various survey organizations working in water-tight compartments. It also helps to raise the general standard of local surveys in accordance with the requirements of a better educated population. This kind of co-operation, combined with provincial devolution and other modern delights, however beneficial to the country, involves a heavy increase in the difficulties of survey administration.

5. *Organization.*—The three enormous Survey Circles, into which India was divided before the War, were much too large to allow of the survey administration maintaining that close touch with Provinces and States, and with local developments of all kinds, which the above policy requires. Burma was therefore detached from the Eastern Circle in 1922 to form a separate Circle, with most excellent results.

This however still left the Northern and Southern Circles as large and unwieldy as ever. In addition, modern mobilisation and frontier survey requirements now demand a more intimate touch with the North-West Frontier and with Army Headquarters than is at all possible to a Northern Circle Directorate stationed at Mussoorie. It has therefore been decided, with effect from the 1st October 1925, to rearrange the present Northern and Southern Circles into three Circles, namely the *Frontier Circle, Central Circle* and *Southern Circle*, with headquarters respectively at Simla, Mussoorie, and Bangalore. The area of the

Frontier Circle will correspond roughly with that of the Northern and Western Commands, which at present form part of the Northern Circle, while the Central Circle will include the balance of the present Northern Circle together with the Central Provinces, which it will take over from the Southern Circle. The Frontier Circle will itself be divided into two *Divisions.*' The Deputy Director Northern Divn. will recess with 'A' Survey Company at Murree, the summer headquarters of the Northern Command, and the Deputy Director Western Divn. will recess with 'E' Survey Company at Quetta, the headquarters of the Western Command. It is hoped to maintain Air-Survey Sections with both Survey Companies. This improved organization should greatly assist in the further development of the policy indicated in para. (4), while enabling us to bring our survey mobilisation arrangements more into line with modern requirements.

6. *Guide maps.*—There is a growing demand for a handy series of maps showing up-to-date information for motorists, and for general use, and this will be emphasised when we have aircraft of various kinds working over the country. None of our present series of maps are well suited to these purposes, and the arrangements by which they are supposed to be kept corrected to date are very inadequate and unsatisfactory. The nucleus of No. 12 Party in Shillong has therefore been employed during the year in experimenting with a new series of "guide maps" on a scale of 10 miles to one inch, and it is hoped that samples may soon be ready for general criticism and the orders of Government. In view of the fact that over about half of India our latest surveys are from 20 to 100 years old, up-to-date information is only obtainable by the cordial co-operation of the local officials in the various Provinces and States. It is hoped that the smaller Survey Circles referred to in para. (5) above, will assist us in eliciting the necessary local assistance; but small permanent offices would have to be maintained in each Circle for the purpose and a considerable effort will be needed at the outset.

7. Notable events of the Survey year were as follows:—

(*a*) Khan Sahib Afraz Gul Khan of the Survey of India was attached to the Netherlands Exploration Party under Mr. P. C. Visser, which left Srinagar for Hunza in April. Reports received from Mr. Visser indicate that K. S. Afraz Gul has done excellent work in the survey of these difficult regions, and has mapped some important areas which are at present shown blank on our maps, *vide* para. (106).

(*b*) *International Congresses.*—It is to be regretted that the arrangements for delegates from the Survey of India to the

International Geodetic Union at Madrid, in 1924, fell through at the last moment, though Colonel Sir Gerald Lenox-Conyngham, F. R. S., kindly acted on our behalf. He reports that Japan had four delegates and Siam two, and that several are necessary if all sections are to be attended. A resolution was passed pressing the urgency of gravity observations in the Himālayas.

The International Geographical Congress at Cairo, last April, was attended by over 400 delegates from other countries. Lt.-Colonel C. P. Gunter, O.B.E., R.E., who represented the Survey of India, has prepared a most interesting report. The Survey of Egypt is producing very excellent work, as a result of the enlightened personal support which it receives from H. M. King Fuad, who is himself a distinguished Honorary Member of the Royal Geographical Society in London.

(*c*) *Officers on leave* have done much useful work in studying modern developments of various kinds. The late Lt.-Colonel H. McC. Cowie, R.E., made a very satisfactory comparison of our Indian pendulums with the standard at Kew, and he and Dr. J. de Graaff Hunter, Sc.D., M.A., F.Inst.P., inspected Dr. Vening Meinesz's pendulum apparatus for submarine determinations of gravity. Dr. Hunter officer also attended the International Union of Astronomy at Cambridge in July; and went into many details of chronometry and wireless longitudes, both in London and with the head of the Geodetic Branch of the French Military Surveys in Paris. Lt.-Colonel R. H. Phillimore, D.S.O., R.E., also collaborated in this connection and has supplied useful notes as a result of his visit to the offices of the Ordnance Survey at Southampton.

(*d*) *Air Survey.*—Major C. G. Lewis, R.E., completed the mapping of the Irrawaddy delta, referred to in last year's Report, and has prepared a valuable account. Captain O. Slater, M.C., R.E., has made some progress with the air-survey of inaccessible areas on the N. W. Frontier, and has begun experimental work in connection with cadastral maps based on air-surveys in Peshāwar and Attock districts, in collaboration with the Royal Air Force; but the work of the latter was much hampered owing to military requirements. Progress on these lines must remain difficult until the R. A. F. becomes able to allot certain units definitely for this special work.

(*e*) *Military Co-operation.*—Lt.-Colonel M. O'C. Tandy, D.S.O., O.B.E., R.E., was on special duty throughout the winter, in the Northern and Western Commands, studying the questions of Frontier Surveys and survey mobilisation, with a view to the establishment of the Frontier Circle referred to in para. (5). Incidentally he gave many lectures on surveys and maps at various military stations, including two at the Quetta Staff

College. Lt.-Colonel C. P. Gunter has carried on this Frontier Survey work in Simla during the summer.

Other Directors have also delivered survey lectures at a variety of military stations, and short survey courses have been given to officers of the Royal Artillery. One or two Artillery Practice camps were also visited by Survey officers, as opportunity arose.

8. Personnel.—Casualties, retirements, recruitments and awards were as follows:—

Class I officers:—Lt.-Colonel H. McC. Cowie, R.E., and Mr. H. H. B. Hanby died. The following retired:—Lt.-Colonel G. A. Beazeley, D.S.O., R.E., and Messrs. J. A. Freeman, E. C. J. Bond, Rai Bahadur Jagdamba Prasad and Rai Sahib Hanuman Prasad. Lieut. H. A. Bazley, R.E., reverted to the Home Establishment.

Messrs. C. E. C. French, C. C. Byrne, Rai Sahib Dhani Ram Verma and Mr. W. G. Jarbo were confirmed as Deputy Superintendents and Mr. B. M. Berrill and Rai Sahib Pramadaranjan Ray were promoted temporarily from the Class II Service.

Lieuts. G. F. Heaney, G. H. Osmaston and G. Bomford, Royal Engineers, rejoined from military duty, and Lieuts. J. B. P. Angwin and D. R. Crone, Royal Engineers, were appointed to the Department.

Class II officers:—Mr. P. Williams retired.

A competitive examination for the recruitment of probationers to the Class II Service was held at the various Survey headquarters, 64 candidates being nominated to sit for the examination by the Selection Boards.

Upper Subordinate officers:—Khan Bahadur Sher Jang and B. V. Narayana Rao retired and Mr. Sadik Ali was transferred to the Technical Establishment, Photo.-Litho. Office. Mr. Nabidad Khan died and Mr. Sasadhar Mukarjee was discharged. Four Lower Subordinates were promoted and 14 probationers were appointed, 4 of whom were discharged.

Awards—Conductor W. Smith, Head Draftsman, Army Section No. 6 Drawing Office, was promoted Assistant Commissary with the rank of Lieutenant from 16th November 1924. He was made a Member of the Order of the British Empire in the Birthday Honours in June 1925.

The title of Rai Sahib was conferred on Mr. Sashi Bhusan Mitra, Head Supervisor, Mathematical Instrument Office, in the Birthday Honours in June 1925.

Mr. R. E. Saubolle, Extra Assistant Superintendent, a Corporal in the Simla Rifles, was awarded the Volunteer Decoration for long service.

I. ABSTRACT OF SURVEYS IN EACH PROVINCE AND STATE.

(*For Abstract of Forest and Cantonment Surveys, see Part III, page 14*)

9. Northern Circle.

Kashmīr State.—Gravity and Astronomical latitude operations (p. 15). Exploration survey, *Hunza State* (p. 43).

North-west Frontier Province.—Riverain surveys, Dera Ismail Khān & Peshāwar districts, (p. 26). Settlement and Boundary surveys, Peshāwar district, (p. 28). Revision Cantonment surveys, Bannu, Risalpur, (p. 41).

Punjab.—Riverain surveys, Attock, Jhang and Miānwāli districts, (p. 26). Tahsil Boundary survey, Shekhūpura (p. 26). Four-inch survey of Lahore and environs, (p. 26). Large-scale surveys of Lahore City and Municipal area, (p. 27). Settlement survey, Attock district, (p. 28). Rectangulation, Ferozepore district (p. 27) and Four-inch survey, Ferozepore, Montgomery and Multān districts, for Sutlej Valley Irrigation project, (p. 25). Tertiary levelling for same project, (p. 42). Revision Cantonment surveys, Campbellpore, Murree, and 8 Galis, (p. 41). Revision Survey, Simla, (p. 22). Gravity determinations, (p. 15).

Punjab States. Bahāwalpur.—Rectangulation for the Sutlej Irrigation project, (p. 27). Geodetic levelling (p. 16).

Delhi Province.—No work.

Rājputāna.—Jaipur State. Survey of Jaipur city and environs, (p. 24).—*Kotah State.* Topographical surveys, (p. 24).—Geodetic levelling, (p. 16).

Sind.—Geodetic levelling, (p. 16).

Balūchistān.—No work.

United Provinces.—Topographical surveys, Allahābād, Bāndā, Fatehpur, Partābgarh and Rāe Bareli districts, (p. 23), Jhānsi and Jālaun districts, (p. 24). Boundary demarcation for the Court of Wards, Gorakhpur, (p. 23). Forest surveys, (pp. 23 and 24).

Central India.—Baghelkhand Agency. Topographical surveys, Baraundā, Chaube Jāgirs and Rewah States, (p. 23).

Bundelkhand Agency.—Topographical surveys, Ajaigarh and Charkāri States, (p. 23), Bijnā, Datiā, Orchhā and Samthar States, (p. 24).

Indore State, topographical surveys, (p. 24).

Gwalior State and Khaniādhāna State of Gwalior Residency, topographical surveys, (p. 24).

10. Southern Circle.

Central Provinces.—Two-inch survey, Seoni district, for Seoni Court of Wards, (p. 30). Forest surveys, (p. 30).

Bastar State.—Four-inch boundary surveys, (p. 30).

Bombay.—Topographical surveys, Ahmadnagar, Bombay City, Bombay Suburban, Kolāba, Nāsik and Thāna districts (p. 31). Forest surveys, (p. 32).

Bombay States.—Jawhār State, topographical surveys, (p. 31).

Hyderābād State.—Topographical surveys, Warangal district (p. 30).

Mysore State.—Topographical surveys, Hassan, Kadūr, Mysore and Tumkūr districts, (p. 31). Three-inch surveys of Bangalore and Seringapatam, (p. 31). Boundary between Mysore State and South Kanara district of Madras, (p. 31).

Coorg.—Topographical surveys, (p. 31).

Madras.—Topographical surveys, Guntūr, Kistna and Upper Godāvari districts, (p. 30), Coimbatore district, (p. 31). Boundary survey between South Kanara district and Mysore State, (p. 31).

11. Eastern Circle.

Assam.—Topographical surveys, Sadiyā Frontier Tract, (p. 34). Tea-garden surveys, (p. 35). Astronomical latitude operations, (p. 15). Forest surveys, (p. 35).

Bengal.—Four-inch surveys in Rāniganj coalfield, Bānkurā, Birbhūm, Burdwān districts, (p. 33). Astronomical latitude operations (p. 15). Geodetic levelling, (p. 16). Secondary levelling for Calcutta Corporation, (p. 43). Secondary levelling for East Indian Railway, (p. 43).

Bihār and Orissa.—Topographical surveys in Angul district, in Athmallik, Bāmra, Dhenkanāl, Hindol, Keonjhar, Mayūrbhanj, Pāl Laharā, Rairākhol and Tālcher States, (p. 34). Four-inch surveys in Rāniganj coalfield, Mānbhūm and Santāl Parganas districts (p. 33). Geodetic levelling, (p. 16).

Sikkim and Bhutān.—No work.

Andaman Islands.—No work.

12. Burma Circle.

Boundary survey between Maymyo sub-division and Hsipaw State, (p. 36). Topographical surveys, Amherst district, (p. 37), Kyaukpyu, Sandoway and Thayetmyo districts, (p. 36). Yenangyaung Oil-fields survey, (p. 39). Secondary levelling for P. W. D. (Irrigation), (p. 42), Tertiary levelling for Burma Oil Company, Yenangyaung, (p. 42). Forest surveys, (p. 37).

II.—ABSTRACT OF TOPOGRAPHICAL WORK.

13. The following two tables show respectively the progress of the topographical programme assigned to the Department in 1905 and the out-turns and cost-rates of different parties during the year under report.

In 1913 the Secretary of State sanctioned a scheme for the reduction of the scale of survey of certain sparsely populated areas of India. This will greatly reduce the area of survey on the one-inch scale and consequently accelerate the rate of progress of topographical, surveys shown in Table I below. In order to give a better idea of what work actually lies before the Department, it may be remarked that of the area remaining for survey about 490,000 square miles may possibly be surveyed on the half-inch or smaller scales. There is however at present a tendency to revert to the larger scale in many areas, owing to the pressing requirements of geologists and engineers, and to the military demand for maps on a larger scale.

Table I.—Progress of Topographical Surveys since 1905.

Survey year.	Scales of Survey.	Northern Circle.	Southern Circle.	Eastern Circle.	Burma Circle.	TOTALS.
		Sq. miles.	*Sq. miles.*	*Sq. miles.*	*Sq. miles.*	*Sq. miles.*
1905-13	Mostly 2-inch and 1-inch.	150,856	80,810	27,551	57,042	315,259
1913-14	Mostly 1-inch and ½-inch.	25,052	15,844	7,291	7,599	55,786
1914-15	ditto.	12,334	19,286	2,448	2,608	36,676
1915-16	ditto.	8,168	17,243	2,279	4,652	32,342
1916-17	ditto.	11,689	11,338	3,560	6,163	32,750
1917-18	ditto.	4,202	12,181	3,596	4,800	24,779
1918-19	ditto.	509	7,263	1,764	4,412	13,948
1919-20	ditto.	9,145	11,891	4,311	5,117	30,464
1920-21	ditto.	14,411	14,275	5,766	5,509	39,961
1921-22	ditto.	11,528	21,596	5,970	5,510	44,604
1922-23	ditto.	26,199	20,823	9,144	5,482	61,648
1923-24	ditto.	18,544	28,160	11,363	7,606	65,673
1924-25	ditto.	**12,095**	**21,765**	**4,544**	**5,913**	**44,317**
Areas completed ...		**304,232**	**281,975**	**89,587**	**122,413**	**798,207**
Balance remaining ...		**445,768**	**260,825**	**173,338**	**143,462**	**1,023,393**
Total programme ...		**750,000**	**542,800**	**262,925**	**265,875**	**1,821,600**

Table II.—OUT-TURNS of PLANE-TABLING and COSTS of Topographical Surveys, 1924-25.

Party and Locality. Character of Country. Scale and Class of Survey.	Out-turns of Plane-tabling. Areas on each Scale of each Class. (Sq. miles.)	Out-turns of Plane-tabling. Totals of areas on all Scales. (Sq. miles.)	Costs of Survey including Mapping. Total Costs. (Rs.)	Costs of Survey including Mapping. Cost-rates. (Rs. per sq. mile.)	Remarks.
					NORTHERN CIRCLE.
No. 1 Party—*United Provinces and Central India.*					
Cultivated plains, congested with villages, and low hills densely wooded. **One-inch** Revision Survey ...	3,227	3,227	94,738	29·4	
No. 2 Party—*Central India, Gwalior, Rājputāna and United Provinces.*					
Jungle-clad hills, undulating forests and cultivated plains. **Half-inch** Original Survey ...	6,850	8,868	1,41,151 (a)	16·0	(a) Includes Rs. 22,276 cost of training Class II probationers and soldier surveyors, etc., and Rs. 3,962 payable by the Jaipur State Durbar.
Jungle-clad hills and cultivated plains. **One-inch** Resurvey ...	2,018				
TOTALS, NORTHERN CIRCLE:— 12,095 sq. m. Rs. 2,35,889 Cost-rate 19·5					

Table II.—OUT-TURNS of PLANE-TABLING and COSTS of Topographical Surveys, 1924-25.

Party and Locality. Character of Country.	Scale and Class of Survey.	Out-turns of Plane-tabling. Areas on each Scale of each Class. (Sq. miles.)	Out-turns of Plane-tabling. Totals of areas on all Scales. (Sq. miles.)	Costs of Survey including Mapping. Total Costs. (Rs.)	Costs of Survey including Mapping. Cost-rates. (Rs. per sq. mile.)	Remarks.
						SOUTHERN CIRCLE.
No. 5 Party *Central Provinces.*						
Jungle-clad hills and plain.	**Four-inch** Original Survey ...	19	85	24,531 (b)	288·6 (b)	(b) Excludes mapping of 4-inch.
	Two-inch Revision Survey ...	66				
No. 6 Party—*Hyderābād, Madras and Central Provinces.*						
Partly highly cultivated plains and partly forest-clad hills.	**Half-inch** Original Survey ...	3,027	9,530 (c)	98,464 (c)	10·3	(c) Area and cost of Bastar Boundary survey is excluded.
	Half-inch Revision Survey ...	291				
	One-inch Original Survey ...	6,068				
	One-inch Revision Survey ...	144				
No. 7 Party—*Mysore State.*						
Mostly open undulating plateau with some densely wooded hill areas.	**One-inch** Revision Survey ...	7,532	7,532 (d)	1,22,065 (d)	16·2	(d) Excludes area and cost of 77 square miles of special large scale survey and revision, and of Mysore-South Kanara Boundary survey.
No. 8 Party—*Bombay and Jawhār State.*						
Thickly populated coastal areas and heavily wooded hills of the Western Ghāts.	**One-inch** Revision Survey ...	4,618	4,618 (e)	71,189 (e)	15·4	(e) Excludes area and cost of special forest maps.
TOTALS, SOUTHERN CIRCLE:– 21,765 sq. m. Rs. 3,16,249 Cost-rate 14·5						

Table II.—OUT-TURNS of PLANE-TABLING and COSTS of Topographical Surveys, 1924-25.

Party and Locality. Character of Country.	Scale and Class of Survey.	Out-turns of Plane-tabling. Areas on each Scale of each Class. (Sq. miles.)	Out-turns of Plane-tabling. Totals of areas on all Scales. (Sq. miles.)	Costs of Survey including Mapping. Total Costs. (Rs.)	Costs of Survey including Mapping. Cost-rates. (Rs. per sq. mile.)	Remarks.
No. 4 Party—*Bengal, Bihār & Orissa.*—*(Rānīganj coalfields.)*						**EASTERN CIRCLE.**
Generally open, undulating country cut up by the Ajay, Dāmodar and Barākar rivers with steep jungle-covered hills in the south-western portion and a fringe of coppice jungle on the remaining three sides.	**Four-inch** Original Survey with 10-foot contours.	60	446	85,604 (*f*)	191·9	(*f*) Includes Rs. 1,846 cost of levelling in advance from last year and excludes Rs. 18,462 cost of triangulation, etc., in advance for survey next year. Total cost of party for this year is Rs. 1,02,220.
	Four-inch Supplementary Survey with 10-foot contours.	386				
No. 9 Party—*Bihār & Orissa.*						
Wooded hills and high ground, open and wooded undulating plains.	**One-inch** Original Survey ...	2,774	2,774	1,17,545	42·3	
Sadiyā Frontier Detachment—*Assam.*						
Low densely wooded plains intersected by the Brahmaputra, Dibāng, Sisseri and Dihāng rivers and bordered by high mountains to the north.	**One-inch** Original Survey ...	1,254	1,324	1,06,465 (*g*)	80·4	(*g*) Excludes cost of 10-mile mapping Rs. 963, cost of Tea Garden survey in Sylhet Rs. 5,819 and cost of triangulation and traversing done for detail survey during next year Rs. 34,972.
	One-inch Revision Survey ...	70				
No. 12 Party—*Assam.*						
This party did not take the field but was employed on drawing of 10-mile guide maps of Eastern Circle.		.....	.....	42,640 (*h*)		(*h*) Includes Rs. 963 cost of 10-mile mapping done by Sadiyā Frontier Detachment.
TOTALS, EASTERN CIRCLE:— 4,544 sq. m. Rs. 3,09,614* Cost-rate 68·1						

*Excludes cost of No. 12 Party.

Table II.—OUT-TURNS of PLANE-TABLING and COSTS of Topographical Surveys, 1924-25.

Party and Locality. Character of Country.	Scale and Class of Survey.	Out-turns of Plane-tabling. Areas on each Scale of each Class.	Out-turns of Plane-tabling. Totals of areas on all Scales.	Costs of Survey including Mapping. Total Costs.	Costs of Survey including Mapping. Cost-rates.	Remarks.
		Sq. miles.		*Rs.*	*Rs. per sq. mile.*	
BURMA CIRCLE.						
No. 10 Party—*Upper and Lower Burma.*						
Densely wooded hills	... **Half-inch** Original Survey ...	239	3,308	1,92,535 (*i*)	58·2	(*i*) Includes Rs. 558 cost of mapping forest surveys debitable to the Forest Department, Burma.
Wooded hills, creeks, islands, and mangrove swamps.	... **One-inch** Original Survey ...	3,069				
No. 11 Party—*Lower Burma.*						
High and low ground densely wooded with evergreen forest and numerous outcrops of rock.	**One-inch** Original Survey ...	1,819	2,224	2,00,051 (*j*)	89·9	(*j*) Includes Rs. 10,398 debitable to the Forest Department, Burma.
Cultivated areas, low hills and plains thickly wooded and swamps.	**One-inch** Supplementary Survey	334				
High hills densely wooded	... **Two-inch** Original Survey ...	61				
Low hills densely wooded	... **Four-inch** Original Survey ...	10				
No. 21 (Burma Forest) Party—*Lower and Upper Burma.*						
Densely wooded hills and plains	**Four-inch** Original Survey ...	381	381	1,71,208 (*k*)	449·3 (*k*)	(*k*) The whole cost is debitable to the Forest Department, Burma.
TOTALS, Burma Circle:—			5,913 sq. m.	Rs. 5,63,794	Cost-rate 95·3	
GRAND TOTALS:—			44,317 sq. m.	Rs. 14,25,546	Cost-rate 32·2	

III.—ABSTRACT OF FOREST, CANTONMENT, AND OTHER SPECIAL SURVEYS.

14. Forest Surveys.

United Provinces.—Western Forest Circle. Bāndā Forest Divn., (p. 23).—*Eastern Forest Circle.* Jhānsi Forest Divn., (p. 24).

Central Provinces.—Southern Forest Circle. Chānda Forest Divn., (p. 30).

Bombay.—Northern and Eastern Forest Circles. East Thāna Forest Divn., (p. 32). Kolāba Forest Divn., (p. 32).

Assam.—Eastern Forest Circle Sādiyā Forest Divn., (p. 35).

Burma.—Sittang Forest Circle. North Toungoo Forest Divn., South Toungoo Forest Divn., Shwegyin Forest Divn., North Pegu Forest Divn., (p. 38).

Central Forest Circle.—Pyinmanā Forest Divn., (p. 39).

Hlaing Forest Circle.—Tharrawaddy Forest Divn., Prome Forest Divn., Allanmyo Forest Divn., (p. 39).

Tenasserim Forest Circle.—Thaungyin Forest Divn., (p. 37).

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15. Cantonment and City Surveys, etc.

Northern Circle.—Bannu, Campbellpore, Ferozepore, the Galis, Murree Depôt, Rawalpindi, Risalpur, (p. 41). Simla, (p. 22).

Southern Circle.—Bangalore, Seringapatam, (p. 31).

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16. Special Surveys.

Hunza.—Netherlands Expedition, (p. 43).

Bengal, Bihar & Orissa.— Rānīganj Coalfield Survey (p. 33).

Assam.—Large-scale surveys of tea gardens, (p. 35).

Burma. Yenangyaung.—Large scale surveys of oil-fields, (p. 39).

Punjab.—Sutlej Valley Irrigation Project, (p. 25).

Lahore and Environs survey (p. 26).

Lahore Town survey (p. 27).

Artillery practice camp, (p. 32).

IV.—ABSTRACT OF GEODETIC OPERATIONS.

DIRECTOR:—Lt.-Colonel R. H. Thomas, D.S.O., R.E.

17. *Organization.*—The following parties and offices were administered by the Director Geodetic Branch:—

Nos. 13, 14, 15, 16, 17, 18 and 19 Parties, the Computing and Tidal Office, the Publication and Stores Office, No. 2 Drawing Office and the Forest Map Office.

Full details of the following geodetic operations are being published separately in the Annual Report of the Geodetic Branch.

18. *Deflection and Gravity observations.*—(Nos. 13 and 14 Parties). Astronomical latitudes were observed at eleven stations in Assam, three in Eastern Bengal and fourteen in Kashmīr. Of those in Assam, three were in the Surmā valley, seven in the Brahmaputra valley and one in the Khāsi and Jaintiā hills. The Assam and Bengal results show that the Hayford theory of uniform isostatic compensation is very imperfectly realised in this area. The computation of the astrolabe observations in Kashmīr is in hand.

Pendulum observations were made at various places in the Punjab and in Kashmīr. For time observations in the gravity work the large pattern prismatic astrolabe was used for the first time in India.

19. *Triangulation.*—Primary triangulation has not yet been resumed since the War.

20. *Tidal Operations.*—Self-registering tide gauges were operated at Aden, Basrah, Karāchi, Bombay, Madras, Kidderpore, Rangoon, Moulmein, Bassein and Port Blair. Readings of time and height of high and low tide were made at Bhāvnagar, Chittagong and Akyab by the Port Officers concerned, the results being sent to Dehra Dūn.

Weekly charts of the tidal curves registered on the automatic recorder at Margil were received from Basrah and hourly readings from these charts were utilized to derive fresh constants for the computation of tide-tables for the Port of Basrah.

Moulmein and Port Blair observations were finally closed down during the year.

Tidal predictions for the 1926 and 1927 tide-tables for Basrah and the Indian ports were completed by March 1925. Advance printed copies of tide-tables for 17 ports for 1926 were sent to the Admiralty by the end of that month.

21. *Levelling.*—Work for the new geodetic level net of India was continued according to the programme laid down. The following lines of geodetic levelling were run :—

(*a*) *Sind.*—Karāchi-Hyderābād-Sukkur.

(*b*) *Rājputāna and Bahāwalpur State.*—Govardhanlā-Bhutta Shaikh (near Khānpur).

(*c*) *Sind and Rājputāna.*—Hyderābād-Barmer.

(*d*) *Bengal.*—Howrah-Rānīganj-Dinājpur.

(*e*) *Bengal, Bihār & Orissa.*—Midnapore-Jaleswar.

Total 1,115 miles.

Details of secondary and tertiary levelling for various purposes are given in Part X of this report, (p. 41).

22. No comparator or base-line work was undertaken during the year.

23. *Computing Office.*—Special mention may be made here of the computations in connection with Dr. Hunter's investigation of the Figure of the Earth, and of those in connection with the computations of rectangular coordinates for the military authorities. Numerous other computations both departmental and extra-departmental were carried out, about 225 requisitions being complied with. 34 Degree Sheet Triangulation Pamphlets (including some of the Mesopotamian Triangulation) were compiled, and 48 pamphlets printed off. Magnetic and Meteorological observations were taken throughout the year. The Omori Seismograph recorded 7 earthquakes between 1st October 1924 and 30th September 1925. Sun photographs were taken on 243 days between 1st October 1924 and 30th June 1925.

24. The taking of Solar photographs, which was started in 1878 at the instance of Sir Norman Lockyer for purposes of scientific investigation, was discontinued from 30th June 1925, and the Solar observatory abolished after consultation with the Director of the Science Museum, 5 Kensington, as its upkeep necessitated expenditure which could be more profitably spent on work in which the Survey of India was more directly interested, and as moreover a better-equipped observatory for this purpose had been established at Kodaikānal.

25. Full details of the work of the Publication and Stores Office, No. 2 Drawing Office and Forest Map Office are now given in the Map Publication and Office Work Report, only a brief summary being given in Abstract V of this report.

V.—ABSTRACT OF MAP PUBLICATION AND OFFICE WORK.

26. Full reports of the work of the printing offices at Calcutta, Dehra Dūn, &c., and of the drawing offices at all Branch and Circle Headquarters, with *Indexes* showing the progress and present state of map publication on various scales, have been published separately in the *Map Publication and Office Work Report*, from which the following Tables are abstracted to show the net result of all this work in the form of Publications and Issues, for the half year ending 31st March 1925.

27. The Mathematical Instrument Office has always reported in accordance with the financial year, and not the survey year; so its report, which is also included in the Map Publication and Office Work Report, is for a full year up to 31st March 1925. This report describes various interesting developments in connection with instruments for medical research and the Army, as well as for surveying, &c. The following Table shows a slight decrease in gross demands on this office for the supply of instruments, while the value of the out-turn from the workshops shows very little change. The workshop profit was Rs. 46,607 against Rs. 43,313 in 1923-24, and that of the Store was Rs. 10,878 against Rs. 26,348, in the previous year.

	1922-23	1923-24.	1924-25.
	Rs.	*Rs.*	**Rs.**
1. Total value of stores issued to Public Offices as shown in the Profit and Loss statements.	6,25,953	4,46,559	**3,75,024**
2. Value of repairs to instruments received from Public Offices for repairs, and returned in serviceable condition.	1,70,010	1,56,682	**1,28,931**
3. Value of instruments received from Government Offices as no longer required.	83,933	54,824	**51,875**
4. Book value of the stock of instruments, &c., in Serviceable Store.	5,75,844	5,14,985	**3,25,685**
5. Book value of the stock of instruments, &c., in Repairable Store.	1,26,616	1,11,113	**1,04,859**
6. Total value of work done in the Workshop.	4,89,329	3,92,072	**3,82,467**
7. Value of instruments manufactured in the Workshop for Serviceable Store.	1,68,588	1,14,677	**1,42,616**
8. Value of instruments purchased locally.	22,840	13,034	**35,356**
9. Value of instruments and materials obtained from England through the Director General, India Store Department.	2,20,650	1,47,723	**95,750**
10. Average No. of employees and their pay including pension contribution.	No. 554 Rs.1,88,009	No. 402 Rs. 1,57,280	**No. 386** **Rs. 1,52,166**

28. Publications.—The publications of the Department for the half year are shown in the following 3 Tables, of which Table I shows map publications, Table II letterpress publications and Table III an abstract of the publication of modern topographical maps to date.

Table I *(a)*—Maps published at Calcutta.

Class of maps.	Scale.	New Publications.	New Editions and Reprints.	Number of sheets printed.	Value.
					Rs.
GENERAL MAPS.		*Departmental.*			
Maps of India	Various	...	2	3,040	4,560
GEOGRAPHICAL MAPS.					
Map of India	1"=32miles	...	...	...	...
Southern Asia Series ...	1:2,000,000	...	...	...	...
India and Adjacent Countries Series.	1:1,000,000	2	...	1,000	1,500
La Carte Internationale du Monde.	1:1,000,000	...	...	...	...
TOPOGRAPHICAL MAPS.					
Quarter-inch, (Modern) ...	1"=4 miles	22	10	12,800	19,702
Do. (Prely.) ...	1"=4 miles	2	2	2,650	5,881
Do. (Provl.) ...	1"=4 miles	...	2	400	600
Half-inch, (Modern) ...	1"=2 miles	33	8	14,700	43,994
Do. (Prely.) ...	1"=2 miles	...	...	...	...
One-inch, (Modern) ...	1"=1 mile	59	22	31,095	47,994
Do. (Prely.) ...	1"=1 mile	9	1	2,500	3,750
Do. (Provl.) ...	1"=1 mile	1	...	240	360
Old Style sheets	Various	...	15	1,660	2,127
SPECIAL MAPS.					
District Maps	1"=4 miles	...	...	...	...
Administration Report Maps ...	1"=8 miles	...	...	...	...
Provincial Maps	Various	1	1	562	1,333
Plans of Cities and Cantonments	Various	1	...	1,120	3,920
Index Maps	Various	...	78	180 975	17,686
Miscellaneous Maps ...	Various	7	12	23,928	13,983
Total ...	.....	**137**	**153**	**276,670**	**1,67,340**
		Extra-departmental.			
Maps	Various	79	15	47,953	19,867
Plans and Diagrams ...	Various	174	6	28,390	4,532
Illustrations	.....	118	...	54,559	11,229
Miscellaneous	.....	32	16	60,570	5,248
Total ...	.....	**403**	**37**	**191,472**	**40,876**
Grand Total ...	.....	**540**	**190**	**468,142**	**2,08,216**

Table I *(b)*—Maps published at Dehra Dūn.

Class of maps.	Scale.	New publications.	Reprints and New Editions.	Number of sheets printed.	Value.
		Departmental.			Rs.
Cantonment Maps ...	Various	1	9	8,570	17,810
Forest Maps	,,	28	17	2,711	3,761
Miscellaneous	,,	1	2	2,600	610
Total ...	...	**25**	**28**	**13,881**	**22,181**
		Extra-departmental.			
Maps	Various	15	6	9,785	4,692
Plans & diagrams ...	,,	6	4	26,569	2,035
Charts	4″	345	...	172,500	26,220
Total ...		**366**	**10**	**208,854**	**32,947**
Grand Total ...		**391**	**38**	**222,735**	**55,128**
Various	Various	60	12	12,700	36,800

Notes.

29. *Calcutta.*—Map Publication was considerably delayed by the heavy work of surprinting minute meshes for the Army Department on a very large number of maps already published. As these maps were trimmed and also in many cases folded, the surprinting could only be effected in hand-presses and registration was difficult and often imperfect. This work left insufficient hand-presses for ordinary proof work.

30. *Dehra Dūn.*—Ten Cantonment and forty Forest maps were published during the period under report, and a large amount of extra-departmental work was done. For the Sutlej Valley Irrigation Project of the Punjab Government 345 special contoured spot-level charts were published. These were reproduced in the Vandyke Section and caused a great increase of work in that section, the out-turn of negatives being 124 in November and the average monthly out-turn being 90 negatives. The correcting of these negatives threw a great deal of work on the Zinc Correcting Section which had some difficulty in keeping up with it.

The out-turn of the litho. machine increased from 29,000 pulls and 16,500 copies printed in October to 65,000 pulls and 37,200 copies printed in March, the out-turn for March being the highest reached during the last three years.

Table II.—Letterpress Publications.

(a) PUBLISHED AT CALCUTTA.

1. Survey of India General Report, 1923-24. Price Rs. 2 or 3s. 6d. (475 copies.)
2. Hand-book of Topography, Chapter VII, Third Edition, 1924. Price Annas 8. (500 copies).
3. Notes on the Organisation, Methods and Processes of the Photo.-Litho. Office, Calcutta, Third Edition, 1924. (350 copies).
4. Catalogue of maps published by the Survey of India, 1924. Price Re. 1. (Printed by Litho.). (3,000 copies).
5. Catalogue of maps of Burma, 1925. Price Annas 8 (750 copies).
6. Office Manual (Map Record & Issue Office), 2nd Edition, 1924. (100 copies).
7. Correction to the Hand-book of Topography, Chapter I, No. 27. (750 copies).
8. Corrections to the Hand-book of Topography, Chapter VI, Nos. 129, 130, 131, 132, 133, 139, 140, 143 & 147. (650 copies each).
9. Correction to the Hand-book of Topography, Chapter X, No. 18. (600 copies).

(b) In Hand at Calcutta.

1. *Hand-book of Topography, Chapter V.*
2. *Hand-book of Topography, Chapter VIII.*
3. *Hand-book of Topography, Chapter XI.*
4. *Correction to the Hand-book of Topography, Chapter I.*
5. *Appendix XI to Hand-book of Topography, Chapter VI.*

(c) PUBLISHED AT DEHRA DŪN.

1. Tide-tables for 1926 for the 14 ports included in the Admiralty tide-tables. (13,280 copies).
2. New data for levelling pamphlets 57, 47 and 66. (550 copies).
3. Eight Triangulation pamphlets. (800 copies).

(d) In Hand at Dehra Dūn.

1. *Records of the Survey of India, (Magnetic Survey).*
2. *Tidal Chapter of the Hand-book of Trigonometrical Instructions.*
3. *Levelling pamphlet 44.*
4. *Hand-book of Topography, Chapter IX.*
5. *Report on Irrawaddy Delta Air Survey by Major Lewis.*
6. *Bhutan and Tibet Survey (Captain Meade).*
7. *Synopsis of Cantonment Surveys.*
8. *Forest Map Office Record Book.*
9. *Corrections to Routes in Western Himalaya, Vol. I.*

Table III.—Publication of Modern Topographical Maps.

Years of publication.	NUMBER OF SHEETS PUBLISHED.		
	One-inch Sheets.	Half-inch Sheets.	"Degree" Sheets.
1924-25 (Half-year)	59	33	6
Previous years	2,098	507	119
Total published ...	**2,157**	**540**	**125**
Number of Sheets in India ...	**6,218**	**1,630**	**450**

31. Map Issues.—The following Tables show the number of maps issued during the half-year.

Table IV *(a)*.—Map Issues, Calcutta.

	On Book Transfer (to Government Officials).		On Cash Payment.		Free Issues.		TOTAL.	
	Number of Copies.	Value Rs.	Number of Copies.	Value Rs.	Number of Copies.	Value Rs.	Number of Copies.	Value Rs.
Departmental.	110,278	1,11,794	39,898	54,542	25,924	36,595	176,100	2,02,931
Extra-departmental.	174,989	40,328	23,325	8,270	6,720	940	205,034	49,538
Total ...	**285,267**	**1,52,122**	**63,223**	**62,812**	**32,644**	**37,535**	**381,134**	**2,52,469**

Table IV *(b)*.—Map Issues, Dehra Dūn & Circles.

Branch or Circle.	On Book Transfer (to Government Officials).		On Cash Payment.		Free Issues.		TOTAL.	
	Number of Copies.	Value Rs.	Number of Copies.	Value Rs.	Number of Copies.	Value Rs.	Number of Copies.	Value Rs.
Dehra Dun (F. M. O.).	1,616	2,341	538	1,174	1,868	4,905	4,022	8,420
Northern Circle	.....	.....	14	26	.....	.....	14	26
Southern Circle	.....	.....	1,675	3,238	.....	.....	1,675	3,238
Total ...	**1,616**	**2,341**	**2,227**	**4,438**	**1,868**	**4,905**	**5,711**	**11,684**

32. Map Record and Issue Office, Calcutta.—During the half-year ending 31st March 1925, sales both to the public and to Government Officials again showed a steady increase.

The re-organization of the Record room continued; up to date, the steel fire-proof rack construction completed and in hand was:—

Map Record Section.—5,230 fixed racks constructed and 1,344 in hand, against 5,810 modern maps published to date.

Original Section.—560 almirahs under construction with shelves on rollers, accommodating altogether 6,720 fair originals, against 5,212 modern fair originals received to date for storage.

VI.—SURVEY REPORTS, NORTHERN CIRCLE.

DIRECTOR:—Lieut.-Colonel L. C. Thuillier, I.A.

33. Summary.—The following parties, detachments, etc., were administered by the Northern Circle during the year:—

Nos. 1, 2, 3, 20*, 22, 23 Parties, No. 3 Drawing Office, the Settlement Survey Detachment and the Nepāl Survey Detachment. No. 3 Party did not take the field, but the post of Officer in charge was held by Major J. D. Campbell, D.S.O., R.E., who acted as Assistant Director, Punjab Surveys, for the co-ordination of the various parties and detachments doing special work for the Punjab Government. No. 20 Party, which reverted to the control of the Director Geodetic Branch during the year, was able to take up special survey work for the Sutlej Valley Irrigation Project, owing to the very small amount of Cantonment work in hand. (p. 25).

34. *Simla Surveys.*—During the winter two surveyors were sent to Simla to take up the revision of the survey on scale 125 feet to one inch. The work was supervised by the Officer in charge No. 6 Drawing Office and the new guide map on the 8-inch scale is now under publication.

35. *Training.*—Of the 60 pupils entertained last year and employed on 4-inch work in No. 20 Party, 8 have been discharged for unsatisfactory work.

9 of these pupils were sent to No. 22 Party at Lahore for large scale surveys in April and the remainder employed during recess in No. 23 Party and No. 3 Drawing Office.

20 new pupils have been entertained during the year for employment in No. 20 Party.

Of the nine soldier surveyors who were receiving instruction in No. 2 Party, three have been reverted to their regiments, as they were not likely to turn out good surveyors.

36. *Party Reports.*—Particulars of the work done by Nos. 1, 2, 20*, 22 and 23 Parties and that of the Settlement Survey Detachment are given below. The work of No. 20 Party (Cantonment Section) is briefly described in Part X, p. 41.

*To 15th June 1925. Sutlej Valley four-inch survey only.

37. No. 1 Party. *Topographical Surveys.*—This party surveyed a total area of 3,227 square miles on the 1-inch scale. This includes 2,901 square miles in the Allahābād, Bāndā, Fatehpur, Partābgarh and Rāe Bareli districts of the United Provinces and 326 square miles in the Indian States of Baraundā (104 square miles), Chaube Jāgirs (109 square miles) and Rewah (106 square miles) of the Baghelkhand Agency, and Ajaigarh (1 square mile) and Charkhāri (6 square miles) of the Bundelkhand Agency of Central India. In addition, an area of 539 square miles was triangulated in the Bāndā district and Rewah State to supply data for the detail survey.

PERSONNEL.

Class I Officer.

Mr. M. C. Petters, in charge to 8th October 1924 and from 9th November 1924 to 17th May 1925.

Class II Officers.

Mr. J. C. C. Lears, in charge from 18th May 1925.

Major C. H. Tresham, in charge from 9th October 1924 to 8th November 1924.

Mr. O. D. Jackson.

„ Moqimuddin.

Upper Subordinate Service.

1 Officer.

Lower Subordinate Service.

30 Surveyors, etc.

38. *Forest Surveys.*—In the Bāndā Forest Divn., of the Western Forest Circle, United Provinces, an area of 57 square miles of reserved and unclassed forests, for which four-inch sheets already existed, was revised on the one-inch scale, during the work outlined above.

39. *Nature of Country.*—The country surveyed in the northern portion consists mainly of well cultivated plains with numerous lakes, marshes and mango groves, and intersected by several rivers, the principal of which are the Ganges and Jumna. The southern portion of the area consists of low isolated hills, cultivated plains and part of the plateau and northern slopes of the Kaimur range; it is densely wooded and covered with a very thorny undergrowth.

40. *Boundary demarcation for the Court of Wards, Gorakhpur.*—As a result of compromises effected in 1905-07 and 1914-16, which included the transfer of ownership of land on payment, the parties concerned wished the boundary lines, which had been drawn in court on badly distorted tracings, to be marked on the ground. The Collector in charge, Court of Wards, Gorakhpur, asked for the services of an officer to carry out the demarcation and guaranteed payment. An officer was accordingly deputed for the work and the necessary demarcation was completed in January-February 1925.

41. No. 2 Party. *Topographical Surveys.*—This party surveyed a total area of 8,868 square miles on the one-inch and half-inch scales. This includes 2,018 square miles on the one-inch scale in the Jhānsi district of the United Provinces; in the Gwalior State, and in the Khaniādhāna State of the Gwalior Residency; and in the Bijnā, Datiā, Orchhā and Samthar States of the Bundelkhand Agency in Central India. It also includes 6,850 square miles on the half-inch scale in the Jālaun and Jhānsi districts of the United Provinces; in the Kotah State in Rājputāna in the Gwalior State, and in the Khaniādhāna State of the Gwalior Residency; in the Datiā, Orchhā and Samthar States of the Bundelkhand Agency and in the Indore State in Central India.

PERSONNEL.

Class I Officer.

Bt.-Lieut.-Colonel S. W. S. Hamilton, D.S.O., R.E., in charge to 13th January 1925 and from 14th February 1925 to 6th April 1925 and from 16th July 1925.

Class II Officers.

Mr. P. A. T. Kenny, O.B.E., in charge from 14th January 1925 to 13th February 1925 and from 7th April 1925 to 15th July 1925.
Mr. A. J. A. Drake, D.C.M.
,, F. B. Kitchen,
,, M. A. Chowdhury, B.A.
,, S. R. Gupta, B.A., (on probation).
,, J. C. Berry do.
,, T. M. C. Alexander do.
,, M. N. A. Hashmi, B.A. do.

Upper Subordinate Service.

5 Officers.

Lower Subordinate Service.

46 Surveyors, etc.

An area of 4,874 square miles was triangulated in advance for detail survey on the half-inch scale in the Jhānsi district of the United Provinces, in the Kotah and Tonk States in Rājputāna, in the Gwalior State, and in the Bhopāl Agency of Central India.

42. *Forest Surveys.*—In the Jhānsi Forest Divn., Eastern Forest Circle, U.P., the survey of 31 square miles of reserved forest is included in the above details.

43. *Nature of Country.*—The country surveyed consisted partly of open cultivated plains, partly of low rocky ridges covered with dense thorn jungle, and partly of undulating forest land. There was also a great deal of intricate broken ground, deeply cleft, along the banks of the Betwā and Sind rivers, and their tributaries.

44. *Training.*—Nine soldier surveyors and one temporary traverser joined for training during the year and received instruction in drawing in the recess and in plane-tabling during the field season 1924-25.

45. *Jaipur City Survey.*—At the request of the Jaipur State Durbar, the party undertook the traverse of Jaipur City and Environs for a survey on the scale of 64 inches to 1 mile. Two traversers

and two computers were employed, commencing work on 1st February 1925. The traverse was completed on 13th May 1925, and altogether 1,899 stations were fixed and 84·7 linear miles of main and minor traverses run and computed in the field. Plot charts were prepared during the recess in 1925 and sent to the Jaipur Durbar who will complete the detail survey by private agency.

46. No. 20 Party (4-inch Section).*—*Sutlej Valley four-inch survey.*—In September 1924 a considerable addition, comprising 6 officers and 90 surveyors, was made to the party for employment on 4-inch topograghical survey for the Sutlej Valley Irrigation Project. The area for survey included portions of Multān, Montgomery and Ferozepore districts, and fragments of Bahāwalpur State which projected over the north bank of the Sutlej,—a country consisting principally of sterile waste, relieved by scattered villages and patches of scrub jungle, usually in the depressions and channels of the old bed of the Beās. The strip of country along the bank of the Sutlej is well cultivated, but nowhere well provided with roads or means of communication.

PERSONNEL.

Class I Officer.

Mr. C. E. C. French, in charge.

Class II Officers.

Mr. O. N. Pushong.
,, J. H. Johnson.
,, G. A. Norman.
,, D. C. Puri.

Upper Subordinate Service.

3 Officers.

Lower Subordinate Service.

90 Surveyors, etc. and pupils.

An aggregate area of 4,395·6 square miles was surveyed on the 4-inch scale during the season; the topographical details being fixed by measurements or intersection from neighbouring stones of the rectangulation survey. The question of accurate boundaries often presented difficulties, especially in the *Nili-bār*, or wilderness. Information obtained from the villagers or patwāri, often disagreed with that indicated by the *masāvi* or forest plan; and, where evidences of habitation had disappeared, the location of a former claim was often well nigh impossible.

Published sheets were produced in black by photography from original plane-table sections, names being either hand-printed or typed. 100 out of 283 sheets were submitted to press before the party's return to recess and the remainder by the end of July.

For the work of the Cantonment Section of this party, see p. 41.

* Transferred to No. 23 Party from 16th June 1925, on transfer of No. 20 Party to Geodetic Branch.

47. No. 22 (Riverain) Party.—*Traverses*—The party continued the work of traversing and laying down base-lines. 686 linear and 689 square miles of main circuits along the Indus river in Attock, Peshāwar, Miānwāli and Dera Ismail Khān districts and along the Jhelum river in Jhelum district and 3,841 linear miles and 736 square miles of minor traverses in the Indus riverain tracts in Attock and Miānwāli districts and in the Chenāb and Jhelum riverain tracts in Jhang district were executed. 1,033 theodolite stations of the former and 16,630 of the latter in 246 villages were fixed. The corners of 327 squares in 918 square miles were demarcated with permanent mark-stones on the left bank of the Indus river in Attock district, on both banks of the same river in Miānwāli and Dera Ismail Khān districts, and along the Chenāb and Jhelum rivers in Jhang district. These are to serve as bases for future survey and demarcation of boundaries and fields in the river beds. 172 plotted and 79 boundary *masāvis* (settlement mapping sheets) on the scale of 1/1980, 2,308 plotted and 592 boundary *masāvis* on the scale of 1/2640, and 37 four-inch sheets were traced and supplied to the Settlement Officers of Attock, Miānwāli and Jhang districts. Besides these, 302 miscellaneous traces were prepared, and all the traverse stations marked during the field season were plotted on 46 four-inch sheets.

PERSONNEL.
Class I Officer.
Mr. Dhani Ram Verma, R.S., in charge.
Upper Subordinate Service.
6 Officers.
Lower Subordinate Service.
38 Surveyors, traversers, etc., (excluding 42 purely temporary men).

48. *Boundary Survey.*—This work consisted in a plane-table survey of the boundaries of the newly constituted tahsīls of Shekhūpura district. For this the original field sheets of the area topographically surveyed in the years 1910-12 were used. 257 linear miles of the new boundaries were surveyed by interpolation and measurement from the surrounding detail and from the village trijunction pillars shown on the original field sheets. The work was commenced on the 11th September 1924 and finished on 11th December 1924.

49. *Lahore & Environs Survey.*—This was undertaken at the request of the Chief of the General Staff, Army Head Quarters, India. It comprised revision of the existing 4-inch maps of the area and their extension to include the adjoining rural area, besides the revision of the Town Guide Map on the scale of 16 inches to 1 mile. The area of the 4-inch revision survey and original survey carried out was 43 and 35 square miles respectively; that of the 16-inch revision was 2·3 square miles. The original survey was based on a theodolite traverse connected

with the Lahore Town traverse executed in 1920-21. 121 linear miles were traversed and 307 theodolite stations were fixed for the purpose. The data of the Lahore Town traverse was also utilised in the revision survey.

50. *Lahore Town Survey.*—This was undertaken at the request of the Chairman of the Punjab Town Improvement Trust, who required maps of Lahore,

(*a*) on the scale of 1 inch to 100 feet for the city proper and congested areas outside the old city walls,

(*b*) on the scale of 1 inch to 330 feet for the rest of the municipal area and for important areas outside the municipal boundary, excluding portions on the north, east and west.

The survey was carried out in the hot weather from 1st May to 20th September 1925. 2·20 square miles on the scale of 1 inch to 100 feet and 27·94 square miles on the scale of 1 inch to 330 feet were surveyed.

The work was based on the Lahore Town traverse executed by the party in 1921. The missing traverse stations numbering 1,960 were relaid and 16·93 linear miles of supplementary traversing with theodolite were carried out and 325 stations were fixed in the new congested areas.

51. No. 23 (Punjab Rectangulation) Party.—*Sutlej Valley Irrigation Project.*—During the year the party was employed on rectangulation in connection with the Punjab Government's Sutlej Valley Project in the Ferozepore district and in Bahāwalpur State.

PERSONNEL.*

Class I Officers.

Mr. E. C. J. Bond, V.D., in charge up to 12th April 1925.

Major J. D. Campbell, D.S.O., R.E., in charge from 13th April 1925.

Class II Officers.

Mr. C. West from 30th October 1924 to 14th June 1925.

Mr. A. M. Talati, L.C.E.

,, F. W. Smith.

,, Abdul Karim, B.A., from 12th March 1925.

Upper Subordinate Service.

3 Officers.

Lower Subordinate Service.

15 Traversers, etc., (excluding 84 purely temporary men).

A total area of 3707·34 square miles was rectangulated, 23,727 rectangles of 100 acres each were laid out, and 23,092 corner stones of 100-acre rectangles were embedded.

The country under rectangulation in the Ferozepore district lies on the south bank of the Sutlej river and is well cultivated and fed by inundation canals. That in Bahāwalpur State lies on the south bank of the Panjnad and Indus rivers, and consists partly of well cultivated land, interspersed with heavy jungle, and partly of open desert areas.

In recess the party was employed on the compilation of *masāvis* of the area rectangulated.

* Excludes personnel of 4-inch Section transferred rom No. 20 Party on 16th June 1925.

As it was found that contour sheets prepared in Dehra Dūn from spot levels alone were unsatisfactory, compilation of revised contour sheets was also undertaken and completed during recess, with the aid of the detail on the 4-inch sheets.

52. Settlement Survey Detachment.—The detachment continued the work of traversing, triangulating, and completing the work done last year in districts Peshāwar (tahsils Chārsadda, Mardān, and Swābi) and Attock (tahsils Attock and Pindi Gheb) for the Settlement Officers.

PERSONNEL.

Class II Officers.

Mr. Maya Das Puri, R.S., in charge.
„ Abdul Karim, B.A., up to 31st December 1924.
„ Prafulla Kumar Ghosh, B.Sc., F.R.G.S., from 10th October 1924 to 31st August 1925.
„ Mahammad Najamuddin, B.A., from 1st June 1925.

Upper Subordinate Service.

7 Officers.

Lower Subordinate Service.

16 Surveyors, Traversers, etc. (excluding 66 purely temporary men).

The Government of India sanctioned the traversing of the whole of the Peshāwar district and so the strength of the detachment was considerably increased by entertaining and training new hands locally.

Special arrangements were made for the protection of men working along the frontier border.

53. *District Boundary Survey.*—At the request of the Settlement Officer, Peshāwar, the survey of the district boundary adjoining the independent tribes, and the internal village boundaries, generally running along the ridges of high hills, was undertaken on the scale of 24 inches to a mile during March, April and May.

54. *Arrāwali Post.*—As asked by the Military Works Department about 2 square miles near Arrāwali Post were plane-tabled for the Commanding Royal Engineer, Kohāt, on the scale of 16 inches to a mile showing topographical detail, clinometric heights, and form contours at intervals of 20 feet in height during February.

55. *Out-turn.*—The following work was completed for the Settlement Officers :—

Peshāwar :—3,014 linear miles were traversed in 600 square miles (21 in Chārsadda, 108 in Mardān and 471 in Swābi) of 142 villages, and 10,043 theodolite stations laid out on the ground. 35 square miles were triangulated and 87 stations were fixed with theodolite. 92·10 linear miles of the district boundary and 77·68 linear miles of village boundary were surveyed on the scale of 24 inches to a mile. 987 square miles were computed and plotted; and 4,331 plotted *masāvis* (settlement mapping sheets) and 55 riverain compiled boundary *masāvis* on the scale of 24 inches to a mile, and 435 four-inch village indexes and their traces

were supplied to the Settlement Officer. Besides these 1,511 miscellaneous traces were prepared and all the work done during the year was plotted on 79 four-inch sheets. The boundary maps of 242 villages were reduced by pentagraph to the one-inch scale and compiled on 16 one-inch topographical sheets. The 24-inch surveyed boundaries were transferred on 192 patwāries *masāvis*. The areas of 80 villages were taken out by planimeter and graphically from the settlement maps.

Attock:—2 square miles were experimentally triangulated in villages Kohāla and Kohāli of the Pindi Gheb *tahsīl* during November for the detail survey on the scale of 16 inches to a mile. 14 stations were fixed with theodolite and 89 by plane-table intersection along village boundaries and in cultivated bits; and 4 plotted *masāvis* showing the points were supplied to the Settlement Officer. 225 square miles of 8 villages in the same *tahsil* were triangulated and 676 stations fixed with theodolite for the aero-photo survey on the scale of 16 inches to a mile and 226 plotted *masāvis* of 8 villages were supplied. 7·98 linear miles were traversed in 0·76 square mile of village Kamālpur Saidān in the Attock *tahsīl*, 26 stations fixed with theodolite; 4 plotted *masāvis* on the scale of 24 inches to a mile, and one four-inch index were supplied to the Settlement Officer for the detail survey.

The stations of two villages Bura and Qāziābād of the Attock *tahsīl* traversed last year, were first whitewashed with a circular ring 3 feet wide and 15 feet in diameter; and then marked on the photographs by fixing them from the nearest detail for the aero-photo survey for Settlement purposes.

56. *Nature of Country.*—The ground in the Peshāwar district consisted of intricate high hills along the frontier border while internally it was open, flat, highly fertile, and well irrigated. In the Attock district it was generally undulating, broken, hilly, and poorly cultivated.

VII.—SURVEY REPORTS, SOUTHERN CIRCLE.

DIRECTOR { Lt.-Col. C. M. Browne, C.M.G., D.S.O., R.E., up to 10th November 1924.
Lt.-Col. G. A. Beazeley, D.S.O., R.E., from 11th November 1924 to 11th May 1925.
Lt.-Col. M. O'C. Tandy, D. S. O., O. B. E., R. E., from 12th May 1925.

57. Summary.—The parties, etc., administered by the Southern Circle during the year were Nos. 5, 6, 7 and 8 Parties, and No. 4 Drawing Office.

The Officer in charge of No. 5 Party, in addition to his normal duties, acted as technical adviser on survey matters to the Government of the Central Provinces, and administered their revenue, town and other local surveys.

58. *Recess Work.*—8 sheets on the one-inch scale were submitted for publication to the circle office before the 30th September 1925. The remaining 68 sheets surveyed on the one-inch and half-inch scales during the year will be submitted before the parties take the field, so that there will be no arrears of fair-mapping in party offices.

59. No. 5 Party.—*Forest Surveys.*—This party carried out forest surveys on the four-inch scale of an area of 19 square miles in the Chānda Forest Divn. of the Central Provinces.

PERSONNEL.
Class I Officers.
Major F. B. Scott, I.A., in charge to 27th November 1924.
Major H. E. Roome, M.C., R.E., in charge from 28th November 1924.
Class II Officers.
Mr. J. H. S. Wilson.
" N. N. Chuckerbutty.
Upper Subordinate Service.
1 Officer.
Lower Subordinate Service.
12 Surveyors, etc.

The boundaries of eleven extensions comprising 90 linear miles in the Bālāghāt Forest Divn. were traversed and an area of 3,840 square miles in the Seoni, Mandlā, Bālāghāt, Bhandāra and Chānda districts was triangulated.

60. *Seoni Court of Wards.*—An area of 76 square miles of special survey for the Court of Wards on the two-inch scale in the Seoni district was also undertaken.

61. *Nature of Country.*—The country surveyed consists of jungle-clad hills and plain.

62. No. 6 Party.—*Topographical Surveys.*—This party completed an area of 3,027 square miles of original and 291 of revision half-inch survey, and 6,068 square miles of original and 144 square miles of revision one-inch survey in the Upper Godāvari, Kistna and Guntūr districts of Madras and Warangal district of Hyderābād. Six square miles of original four-inch survey in connection with the boundary delimitation of Bastar State (Central

PERSONNEL.
Class I Officers.
Major R. S. Wauchope, O.B.E., I.A., in charge from 5th December 1924.
Lieut. G. Bomford, R.E.
Class II Officers.
Mr. E. A. Meyer, in charge up to 4th December 1924.
Mr. A. F. Murphy.
" E. N. Natesan, B.A.
" Muhammad Najamuddin, B.A.
" C. P. E. Davenport.
Upper Subordinate Service.
4 Officers.
Lower Subordinate Service.
50 Surveyors, etc.

Provinces) and Madras were also carried out. An area of 12,853 square miles of triangulation was completed in the Chānda district of Central Provinces and Nirmal, Karimnagar and Warangal districts of Hyderābād; 105 linear miles of theodolite traversing were carried out.

63. *Nature of Country.*—The country under survey varied from flat highly cultivated and populated areas to dense forest-clad hills.

64. No. 7 Party.—*Topographical Surveys.*—This party surveyed an area of 7,525 square miles in the Hassan, Kadūr, Mysore and Tumkūr districts of Mysore State on the one-inch scale, also one square mile of Coorg and 6 square miles of Coimbatore district of Madras on the same scale. The party also triangulated an area of 3,200 square miles in the Bellary district of Madras and in the Raichūr district of Hyderābād.

PERSONNEL.

Class I Officer.

Major H. T. Morshead, D.S.O., R.E., in charge.

Class II Officers.

Mr. V. W. Morton.
" J. C. St. C. Pollett.
" N. S. Hariharu Iyer.

Upper Subordinate Service.

3 Officers.

Lower Subordinate Service.

40 Surveyors, etc.

65. *Station Surveys.*—Surveys of 69 square miles of the city and civil and military station of Bangalore and 8 square miles of the island of Seringapatam were executed on the three-inch scale with a view to the publication of guide maps.

66. *Nature of Country.*—The country surveyed mostly consisted of open undulating plateau averaging slightly under 3,000 ft. in elevation; but densely wooded hills rising to 6,000 ft. were met in the western portion of Kadūr district.

67. *Mysore-Madras Boundary*—In connection with the delimitation of the Mysore and Madras (South Kanara district) boundary, a strip of country about 130 miles long and 40 chains wide was surveyed on the scale of four inches to one mile.

68. No. 8 Party.—*Topographical Surveys.*—This party surveyed an area of 4,618 square miles on the one-inch scale. Of this area, 290 square miles fell in Jawhār State, and the balance of 4,328 square miles in Ahmadnagar, Kolāba, Nāsik, Thāna, Bombay City and Bombay Suburban districts. With the exception of the densely populated plains of the coast, the country surveyed consisted of the heavily wooded heights and foothills of the Western Ghāts.

PERSONNEL.

Class I Officer.

Captain L. H. Jackson, I.A., in charge.

Class II Officers.

Mr. M. Mahadeva Mudaliar, M.A.
" B. T. Wyatt.
" Srinivasa Rao Kelkar, B.Sc.

Upper Subordinate Service.

4 Officers.

Lower Subordinate Service.

32 Surveyors, etc.

An area of 3,669 square miles was triangulated in advance for detail survey on the one-inch scale in the districts of Ahmadnagar and Sholāpur, and in Hyderābād, Mirāj (Senior), and Mirāj (Junior) States.

69. *Forest Surveys.*—At the instance of the Chief Conservator of Forests, Bombay, the party also surveyed 4·6 square miles in the newly afforested areas in Mokhāda Path of the East Thāna Forest Divn., on the four-inch scale; and 209·7 acres of Reserved Forests on the eight-inch scale in the Karjat Tāluka of Kolāba Forest Divn.

70. *Artillery Practice Grounds.*—At the request of the military authorities, points were fixed on the artillery practice grounds at Rājankunti.

VIII.—SURVEY REPORTS, EASTERN CIRCLE.

DIRECTOR :—Lt.-Colonel A. A. McHarg, D.S.O., R.E.

71. Summary.—The parties, etc., administered by the Eastern Circle were Nos. 4, 9, 12 Parties, No. 5 Drawing Office, and the Sadiyā Frontier Detachment. No. 12 Party did not take the field.

In addition to his duties in the Imperial Department, the Director, as Director of Surveys, Assam, held administrative charge of the Assam Survey Department, including the Assam Traverse Party, the Drawing and Reproducing Offices at Shillong and the Assam Survey School at Jhālukbāri. Also in his capacity as technical adviser on survey matters to the Government of Bengal, he visited the Bengal Survey Office at Alipore and the Bengal Traverse Party in the field.

72. *Training.*—All the pupils attached to parties in the field for training appear to be promising and likely to become useful surveyors.

Six more pupils were entertained in April 1925; they were attached for training in field and recess work to No. 5 Drawing Office; two each have now been posted to Nos. 4 and 9 Parties and two to the Sadiyā Frontier Detachment for further training in the field.

Two Upper Subordinate officers of No. 4 Party received training in triangulation, traversing and computations.

73. *Recess Work.*—22 sheets (including 8 of tea gardens) were partly and 16 wholly surveyed by the two parties and the detachment and with the exception of No. 9 Party's sheets, all should be mapped before the next field season starts.

74. No. 4 Party.—*Rāniganj Coalfield Survey.*—This party completed the survey on the four-inch scale of the remaining 446 out of a total of 856 square miles of the Rāniganj coalfield. The survey of 386 square miles was based on reductions of the sixteen-inch cadastral surveys, the remaining 60 square miles being original work.

PERSONNEL.
Class I Officer.
Mr. C. C. Byrne, in charge.
Class II Officers.
Mr. J. McCraken, M.B.E.
Lieut. C. S. McInnes.
Upper Subordinate Service.
3 Officers.
Lower Subordinate Service.
31 Surveyors, etc.

75. *Nature of Country.*—The area lay in two detached portions separated by last year's work. The country in the western portion in the Mānbhūm and Bānkurā districts is fringed along its south-westerly border by steep jungle-covered hills and is broken towards the north by the Dāmodar and Barākar rivers and their feeders. In the eastern portion in the Santāl Parganas, Birbhūm, Burdwān and Bānkurā districts, the country is open on the whole, though cut up by the Ajay and

Dāmodar rivers; it is comparatively well served by roads and railways and contains the important industrial town of Rāniganj and the large railway workshops of Andāl.

76. *Triangulation and traversing.*—The triangulation and traversing of 60 square miles in the Birbhūm district was completed and made use of for the current season's survey and an area of 800 square miles in the Santāl Parganas, Hazāribāgh and Mānbhūm districts was triangulated for future surveys on the one-inch scale.

77. No. 9 Party.—*Topographical Surveys.*—This party surveyed an area of 2,774 square miles on the one-inch scale in the Angul district and the Athmallik, Bāmra, Dhenkānāl, Hindol, Keonjhar, Mayūrbhanj, Pāl Laharā, Rairākhol and Tālcher Feudatory States of Bihār and Orissa.

PERSONNEL.

Class I Officers.

Captain H. R. C. Meade, I.A., in charge to 18th October 1924.
Mr. B. M. Berrill, in charge, from 19th October 1924.

Class II Officers.

Mr. R. E. Saubolle.
,, Bhupendra Nath Saha, M.Sc.

Upper Subordinate Service.

3 Officers.

Lower Subordinate Service.

32 Surveyors, etc.

78. *Nature of Country.*—The area surveyed included part of the Brāhmanī valley, open and wooded hills (chiefly *sāl*) rising to a height of nearly 3,900 feet.

79. *Reconnaissance and Triangulation.*—An area of 2,749 square miles was triangulated for one-inch survey and 575 square miles reconnoitred for triangulation in the Mānbhūm and Singhbhūm districts, in the Mayūrbhanj and Saraikelā States of Bihār and Orissa and in the Midnapore district of Bengal.

80. Sadiyā Frontier Detachment.—*Topographical Surveys.* This detachment, consisting of some of the least skilled draftsmen of No. 12 Party, was formed for convenience of accounts as an independent unit in October 1924. Its programme was that originally allotted to No. 12 Party, but the scale of survey was reduced for retrenchment reasons. A total area of 1,324 square miles on the one-inch scale was completed, 1,254 square miles being original and 70 square miles revision survey.

PERSONNEL.

Class II Officers.

Major J. H. Williams, in charge.
Mr. E. M. Kenny.
,, D. K. Rennick, M.B.E.
,, H. H. Creed.

Upper Subordinate Service.

2 Officers.

Lower Subordinate Service.

28 Surveyors, etc.

81. *Nature of Country.*—The country surveyed lay between the Brahmaputra (Lohit) river and the foot-hills to the north. That east of the Dihāng river is a gently sloping trackless area, densely

wooded with impenetrable evergreens and cane brakes and uninhabited except for a few villages on the banks of the Dihāng river as well as in the neighbourhood of Sadiyā and the main Sanpurā road. West of the Dihāng, in the southern area especially, lie several large *chaparis* or long elephant grass covered patches, and nearer the foot-hills, extensive "*Jhum*" cultivated areas belonging to the villagers living in these foot-hills, the intervening country being all densely wooded. Owing therefore, to the inability to see any distance without clearing, and owing to the prevalence of leeches with the advent of the warmer weather and the first rains, survey operations were both costly and of a laborious nature and were carried out under exceedingly unpleasant conditions.

105 linear miles were traversed to assist the current year's survey. An area of 1,235 square miles was triangulated for survey during the ensuing year and 1,000 square miles were reconnoitred in advance of next field season's triangulation.

82. *Forest Surveys.*—In the Sadiyā Forest Divn. of the Eastern Forest Circle, Assam, an area of 135 square miles was surveyed on the one-inch scale in the Pāsighāt, Poba, Kokoramara, Hologaon, Sadiyā East, Sadiyā West, Bāli Jān, and Kerim reserved and protected forests. The Deopāni protected reserve was also surveyed on the same scale, but as its boundaries have not been demarcated, it is not possible to include its area in the above.

83. *Tea Gardēn Surveys.*—At the request of Messrs. Duncan Brothers & Co., Calcutta, Managing Agents for the following tea gardens, one Upper Subordinate Officer with 6 surveyors surveyed an area of 17·17 square miles on the six-inch scale with contours at 20-foot vertical intervals in the Amo, Satchuri, Mādhabpur, Padmachara, Patrakhala, Kurmachara, Bagāchara and Champaray tea gardens. The work was begun in April and completed in June. As these maps are required in connection with anti-malarial schemes, they will be fair-drawn at the Managing Agent's request on the twenty-inch scale and the whole cost amounting to Rs. 10,500 will be borne by them.

IX.—SURVEY REPORTS, BURMA CIRCLE.

DIRECTOR { Lt.-Col. R. H. Phillimore, D.S.O., R.E., to 10th December 1924.
{ Lt.-Col. E. T. Rich, C.I.E., R.E., from 11th December 1924.

84. Summary.—The parties, etc., administered by the Burma Circle were Nos. 10, 11, 21 Parties, No. 7 Drawing Office and the Yenangyaung Survey Detachment.

85. *Training.*—At the beginning of the year 16 pupils were under training, of whom 6 were attached during the winter to No. 7 Drawing Office for instruction in surveying at Maymyo and the remainder were attached to parties.

Of these 16 pupils, three were discharged, in the spring as unlikely to become useful surveyors; the remaining 13 are very promising.

In addition, 17 new pupils were enlisted during the summer and were attached to No. 7 Drawing Office for instruction in drawing.

86. *Irrawaddy Delta.*—Major Lewis completed the maps resulting from the air survey of the Irrawaddy delta of the previous year. A full report has been published by the Burma Forest Party.

Hsipaw Boundary.—At the request of the Commissioner, North-east Frontier Divn., one upper subordinate officer and one surveyor of No. 7 Drawing Office were deputed to survey the boundary between Hsipaw State and the Maymyo sub-division of the Mandalay district. The cost was met by the Government of Burma.

87. No. 10 Party.—*Topographical Surveys.* This party surveyed an area of 239 square miles on the half-inch scale in the tribal area between the Mali Hka, and Nmai Hka branches of the Irrawaddy, known as "The Triangle," and 3,069 square miles on the one-inch scale in the Thayetmyo, Kyaukpyu and Sandoway districts of Burma.

PERSONNEL.

Class I Officer.

Captain G. Lennox, I.A., in charge.

Class II Officers.

Mr. S. S. McA'F. Fielding.
" F. J. Grice.
Captain F. E. R. Calvert.

Upper Subordinate Service.

4 Officers.

Lower Subordinate Service.

30 Surveyors, etc.

Supplementary triangulation for topographical surveys was carried out over an area of 2,932 square miles in the Sandoway, Henzada, Bassein and Myaungmya districts of Burma.

88. *Nature of Country.*—The country surveyed on the half-inch scale consists of steep jungle covered hills and on the one-inch scale it includes the large islands of Ramree and Cheduba, many smaller hilly islands, creeks and mangrove swamps fringing an indented coast line, with further inland the well wooded ridges of the Arakan Yoma.

The population is sparse in the hills, where communication is by paths. The coast and larger islands are more thickly populated and here communication is almost entirely by water.

89. No. 11 Party.—*Topographical and forest surveys* were continued in Lower Burma in the Amherst district. The total area surveyed on all scales was 2,224 square miles, comprising 1,849 square miles of original and 334 square miles of supplementary surveys on the one-inch scale; 61 square miles of Reserved Forests on the two-inch scale, and 10 square miles on the four-inch scale. An area of 3,808 square miles of original and supplementary triangulation was carried out in the Amherst and Thaton districts for next season's detail survey, and 5 linear miles of forest boundary were traversed by chain and theodolite.

90. *Tenasserim Forest Circle.*—The forest surveys summarised above are as follows:—

In the *Thaungyin Forest Divn.*, an area of 61 square miles of the Ta-ôk Reserved Forests was surveyed on the two-inch scale; and 6·63 square miles of the Gawle and Kyaukket Extensions, and 3·44 square miles of unclassed forest land were surveyed on the four-inch scale. In addition, in the course of one-inch topographical operations, the old four-inch forest sheets of the Gawle, Ôykarein, Mĕgala, Balĕdo and Kyaukket Reserved Forests were brought up to date, and their external boundaries resurveyed on the four-inch scale.

91. *Nature of Country.*—The whole of the area surveyed is covered with dense evergreen forest, and is a mass of irregular broken hills and low valleys with the exception of the well defined Dawna range. Some of the peaks along the main watershed rise to over 5,000 feet in elevation. In the extreme south-east, a very conspicuous feature of the landscape is the great profusion of massive out-crops of limestone many hundred feet in height.

92. No. 21 (Burma Forest) Party.—*General.* This party surveyed an area of 381 square miles of Reserved Forests on the four-inch scale in the Thayetmyo, Prome, Tharrawaddy, Pegu, Toungoo and Yamethin districts of Burma.

790·5 linear miles of forest boundary theodolite traverses, 28·1 linear miles of boundary surveys on the four-inch scale and 22·9 linear miles of boundary surveys on the two-inch scale were also completed.

PERSONNEL.

Class I Officers.

Mr. H. W. Biggie, in charge to 31st May 1925.

Mr. S. S. McA'Fee Fielding, in charge from 1st June 1925.

Class II Officers.

Lieut. L. B. Fitz-Gibbon.
Mr. T. F. Kitchen.
" H. M. Critchell.

Upper Subordinate Service.

3 Officers.

Lower Subordinate Service.

35 Surveyors, etc.

The details of this work are given below.

93. The country surveyed consists of densely wooded hills and plains with few communications.

94. *SITTANG FOREST CIRCLE.*—In the *North Toungoo Forest Divn.* an area of 121·26* square miles was surveyed on the four-inch scale in the following reserves:—Tônbo, Pyônchaung Extension, Padē, Karenchaung, Gwethe Extension, Samo, Ye-e-myaung, Saing Extension No. II and West Swa Extensions I and II. An area of 28·99 square miles of unclassed forest and cultivation lying between or adjoining the reserves was also surveyed to show villages and communications. 14·34 linear miles of boundary traversing and 1·20 linear miles of connection traversing were carried out in West Swa Extension II.

In the *South Toungoo Forest Divn.* an area of 44·4 square miles was surveyed on the four-inch scale in the Myayabinkyaw and Nyaungchidauk reserves. An area of 0·5 square mile containing the village of Nyaungchidauk and adjoining cultivation was also surveyed to show the approaches to the reserve of that name. The external boundary of the Pauktaw reserve, 21·0 linear miles in length, was added by plane-table to a four-inch plot of the theodolite traversing done along that boundary in 1923-24.

In the *Shwegyin Forest Divn.* an area of 80·20 square miles was surveyed on the four-inch scale in the following reserves:—Chaungma-ngē East and West Blocks, Taunggyi, Yaukthawa and Pada Extension. An area of 7·3 square miles of unclassed forest and cultivation lying between or adjoining the reserves was also surveyed to show villages and communications.

In the *North Pegu Forest Divn.* 56·86 linear miles of boundary traversing and 4·82 linear miles of interior and connection traversing were carried out in the following reserves:—Yēnwē Extension I, Wami, Myogyaung (east boundary only), and Kawliya (east boundary only). An area of 2 square miles in the Myogyaung reserve was surveyed on the four-inch scale to complete the survey of the reserve, the remaining portion having been surveyed on that scale in seasons 1897-98, before the area was notified as a reserve, and 0·8 square mile of unclassed forest adjoining was also surveyed on the same scale. The east boundary of this reserve, 7·10 linear miles in length was added by plane-table to blue prints of the old four-inch field sections. The east boundary of the Kawliya reserve and the boundaries of its six exclusions, 22·91 linear miles in length, were added by plane-table to blue prints of the old two-inch surveys carried out in seasons 1898-01, before the area was notified as a reserve.

* This includes 0·16 square mile of 16-inch scale survey.

95. *CENTRAL FOREST CIRCLE.*—In the *Pyinmanā Forest Divn.* an area of 55·34 square miles was surveyed on the four-inch scale in the following reserves:—Pyinmanā Fuel, Lower Sinthe, Yeni Extension II, Minbyin Extension I and Mehaw Extension. The detail survey of the Mehaw Extension is based on a plane-table traverse of its boundary, connected with triangulated points, the number of linear miles of boundary survey being 8·24. An area of 4·91 square miles of unclassed forest and cultivation lying between or adjoining the reserves was also surveyed to show villages and communications. 241·73 linear miles of boundary traversing and 75·43 linear miles of interior and connection traversing were carried out in the following reserves:—Mancho, Yezin, Byingyē, Natma, Nyaunggaing, Hlwabôn, Kôgwe and Hlwazin.

96. *HLAING FOREST CIRCLE.*—In the *Tharrawaddy Forest Divn.* an area of 32·11 square miles was surveyed in the Teinhmyôk, Kyinichaung, Nyaungbinzin, Kenni and Thewa reserves. An area of 3·12 square miles of unclassed forest and cultivation lying between or adjoining the reserves was also surveyed to show villages and communications.

In the *Prome Forest Divn.*—242·69 linear miles of boundary traversing and 34·23 linear miles of interior and connection traversing were carried out in the following reserves:—Prome Teak Plantation, Tônyē East and West Extensions, Shwekyundaw, Padinbin, Zibinhla, Sēdaing, Sēdaing Extension, Byama-in, Pauktaw Extension, Sinmizwē Extension, Nyaungbindet East Extension, Myebya, Gonbalē, Gonbalē East and North Extensions, Ôlēzwē, Chaungzauk North Extension, *Kayineik, Kayineik North Extension,* Wettaung, Wettaung Extension and *Kyatkôn.*

In the *Allanmyo Forest Divn.*—102·56 linear miles of boundary traversing and 16·66 linear miles of interior and connection traversing were carried out in the following reserves:—East Yoma Extension II, III and IV, Shazibo, Hmunsa and Pyalo.

97. Yenangyaung Survey Detachment. *Oil-field Survey.*—At the request of the Burma Oil Company, Ltd., a large scale survey of the Yenangyaung oil-fields in the Magwe district of Burma was undertaken by one Upper Subordinate officer and four surveyors from the Burma Circle assisted by a levelling detachment of one Upper Subordinate officer and a leveller from the Geodetic Branch (see p. 42). With the object of increasing the accuracy of the ground work, the area was covered by air-photography carried out by the Air Survey Company, Ltd., from Rangoon.

The work was begun in October and completed in May. The area of 5½ square miles was surveyed on the scale of 24 inches to 1 mile with spirit-levelled contours at 10 feet intervals. The whole cost was paid by the Burma Oil Company, Ltd.

X.—MISCELLANEOUS SURVEY REPORTS.

98. Cantonment Surveys, etc.—During the year the Cantonment Section of No. 20 Party completed the revision surveys of Bannu, Campbellpore, Risālpur, Murree Depôt and eight* *Galis* on the 16-inch scale, and the bāzārs of Rāwalpindi on the 64-inch scale. The revision surveys of Rāwalpindi and Ferozepore are nearing completion. 81·09 linear miles of traversing and 124·81 miles of levelling have been completed at a cost of Rs. 70·04 and Rs. 21·29 respectively per mile.

PERSONNEL.
Class I Officer.
Mr. C. E. C. French, in charge.
Upper Subordinate Service.
1 Officer.
Lower Subordinate Service.
21 Surveyors, etc.
*1. Cliffden.
2. Ghariāl & Flats.
3. Upper & Lower Topa.
4. Kuldanna.
5. Chāngla Gali.
6. Khaira Gali.
7. Bāriān.
8. Khanspur & Ghora Dakka.

The fair-drawings of Deolāli, Sitāpur, Muttra, Bareilly, Agra, Naini-Tāl Minor Cantonment, Gorakhpur Notified Area, Sargodha Remount Depôt, Pathānkot Rest camp, and also the bāzār plans of Sitāpur, Muttra, Bareilly and Agra have been completed and submitted for publication.

The out-turns and cost-rates of the various surveys are as follows:—

Twelve-inch	revision,	4,100 acres, @ Re.	0.90 per acre.
Sixteen-inch	revision,	20,184 acres, @ Re.	0·82 per acre.
Sixteen-inch	original,	741 acres, @ Re.	0·82 per acre.
Sixty-four-inch	revision,	139·85 acres, @ Rs.	21·76 per acre.

The total areas fair-mapped, with cost-rates are as follows:—

11,520 acres on the	six-inch	scale @ Re.	0·28 per acre.
4,835 acres on the	twelve-inch	scale @ Re.	0·20 per acre.
18,313 acres on the	sixteen-inch	scale @ Re.	0·37 per acre.
66 acres on the	forty-eight-inch	scale @ Rs.	7·43 per acre.
272 acres on the	sixty-four-inch	scale @ Rs.	5·52 per acre.

99. Commercial Levelling.—Besides the geodetic levelling referred to on p. 16, No. 17 Party carried out the following:—

(*a*) Tertiary levelling for the Sutlej Valley Irrigation Project.

(*b*) Tertiary levelling in the Yenangyaung oil-field.

(*c*) Secondary levelling for the Public Works Department (Irrigation), Burma.

PERSONNEL.
Class I Officer.
Major A. H. Gwyn, I.A., in charge.
Class II Officers.
Mr. N. R. Mazumdar.
„ D. N. Banerji, I.C.E.
Upper Subordinate Service.
4 Officers.
Lower Subordinate Service.
19 Computers, etc.
71 purely temporary Levellers.

(*d*) Secondary levelling for the Calcutta Corporation.

(*e*) Secondary levelling for the Chief Engineer, East Indian Railway.

100. *Sutlej Valley Irrigation Project.*—Tertiary levelling for this project covered 4,900 square miles, in the Multān, Montgomery, Lahore and Ferozepore districts and the Bahāwalpur State, all in the Punjab.

The blocks comprised in the area were:—

I′, J′, K′, N′, O′, R′, B″′, C″′, D″′, S′, T′.
Y″, V″, Z, F′, A′, C′, G′, H′, Z′.
C″, D″, E″, F″, Z″.
I″, J″, K″, N″, O″, P″, R″.
T″, W″, S″.

The country surveyed lies in the flat lands of the valley of the Sutlej river, and in the higher land to the south which merges into the great desert of Rājputāna. In the latter area there are stretches of bare *pat*, with expanses and ridges (most of which are under 25 feet high) of sand; much of the sandy area is covered with fairly open scrub.

101. *Yenangyaung oil-field.*—Tertiary levelling in the Magwe district, in Burma, covered an area of 6 square miles. It was carried out for the Burma Oil Company, Ltd., in connection with the topographical survey of the same area.

The ground is very much broken up with small *nalas* and strewn with oil wells.

102. *The Public Works Department (Irrigation), Burma.*—Secondary levelling in the Shwebo, Tharrawaddy, Insein and Pegu districts of Burma was carried out for this department along the following lines which all lay in flat alluvial country:—

89 D-Tangon to Shwebo	...	...	65 miles
89 E-Kabo to Myittaw	...	...	92 ,,
89 F-Okshitkan to Paukkan	...	...	78 ,,
90 E-Thonze to Rangoon	...	...	110 ,,
88 D-Pegu to Zenyaungbin	...	...	5 ,,
88 E-Myitkyo to Okpo	...	...	7 ,,
88 F-EBM at R. D. 25 of Yenwe embankment to Uaw	...	...	10 ,,
		Total	... 367 miles.

103. *Calcutta Corporation.*—In connection with the city drainage (Bidyādharī river), in the 24-Parganas district in Bengal, secondary levelling was carried out on the following lines :—

Calcutta to Nārāyanpur	...	59 miles.
Nārāyanpur to Nārāyanpur	...	91 ,,
Total	...	150 miles.

The lines lay in the flat inundation lands to the east of Calcutta, and along the banks of the Bidyādharī, Piāli and Mātla rivers.

104. *Chief Engineer, East Indian Railway.*—Secondary levelling was carried out on the following lines in the Howrah, Hooghly and Burdwān districts in Bengal and the Mānbhūm and Hazāribāgh districts of Bihār and Orissa :—

Howrah to Uttarpāra	...	13 miles.
Branch lines from existing lines of levels to Seorāphuli, Bāndel, Pandua, Saktigarh, Burdwān, Khāna, Galsi, Mānkur, Pānāgarh, Durgāpur, Rānīganj, Kālipāhāri, Asansol and Churulia railway stations, amounting in all to		50 ,,
Barākar to Hazāribāgh Road Station and to a connection with existing lines of levels at Bagodar	...	105 ,,
Total	...	168 miles.

The lines lay in the thickly settled areas in Lower Bengal, the more open tract along the Dāmodar river, and in higher land in the Bihār and Orissa districts.

105. *Recess Work.*—The computations of the current season's work were all finished, and the results in manuscript form were sent to the various officers for whom the work was done, and to the press for inclusion in the levelling pamphlets. There are no arrears.

106. The Netherlands Expedition, 1925.—Mr. Ph. C. Visser, Attaché to the Dutch Legation at Stockholm, accompanied by Mrs. Visser and Baron Harinxma, explored the main tributaries of the Hunza river. Khan Sahib Afraz Gul Khan of the Survey of India was attached to him as topographer.

After reaching Gilgit on 16th May, the party established a base camp in the Hunza valley at Pasu twelve days later. The Pasu glacier (14½ miles long) was first explored and mapped, but snow storms prevented

access to the Batura at this time of year. An entry was then forced into the Khūnjerāb gorge and the whole valley explored and surveyed to its glacier sources on the Pāmir watershed. From the upper basin of the Khūnjerāb a pass was made over the range to the south, and the Ghujerāb, which was previously totally unexplored, was entered. Owing to the volume of flood water, the lower Ghujerāb gorge could not be penetrated but the whole of the upper reaches and tributaries were surveyed, as far as the watershed of the Yārkand river basin.

Two passes were forced into the Shingshāl valley, the glaciers of which were now explored for the first time. The discovery of three large glaciers here, — the Virjerāb (24 miles), the Khurdopin (26 miles), and the Yāzghil (18 miles) — was unexpected. These glaciers, together with the Malungatti, were ascended and surveyed. The first two of these appear to take their rise in the great glacier basin of the Biafo, lying athwart the Karakoram axis, first discovered by Godwin Austen in 1861. Khan Sahib Afraz Gul Khan's survey, which emanated from stations of the Indo-Russian triangulation of 1913, was here connected to fixed points of the Survey of India, a small adjustment only being necessary.

On returning to his base at Pasu, Mr. Visser led his party up the Batura glacier. The whole of this with all its branches was also surveyed by Khan Sahib Afraz Gul Khan for the first time. The Batura glacier is 36 miles long, and therefore equal to the fifth longest outside Polar regions.* Practicable passes were noted into the Lupghar tributary of the Chapursān to the north and into the Tutu Uns glacier on the west, but bad weather and lack of supplies forced a retreat.

Before closing work, the party visited Nagir, ascended the Hispar glacier to the junction of the Lak or Kunyang glacier, and effected a topographical connection with the survey of the Shingshāl glaciers. This last connection is valuable, as it enables the earlier surveys of Sir Martin Conway (1892) and of Mrs. Bullock Workman (1908) to be co-ordinated.

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*As far as we know at present the lengths of the six longest glaciers outside Polar regions are as follows:—

Siachen	(Karakoram)	...	...	45 miles.
Inylchek	(Tian Shan)	...	...	44 miles.
Hispar	(Karakoram)	...	...	38 miles.
Biafo	(Karakoram)	...	...	37 miles.
Baltoro	(Karakoram)	...	...	36 miles.
Batura	(Hindu Kush)	...	...	36 miles.

No other glaciers are known as yet to exceed 30 miles in length outside Polar regions.

The total out-turn of the Khan Sahib's survey on the half-inch scale was 2,580 square miles. The country is excessively difficult—probably as difficult as any in the world. Sheer precipices of 10,000 feet wall the gorges in some parts, and the rivers race below in flood. In the main valleys mud and rock avalanches constitute formidable dangers, and the party records one snow avalanche that lasted almost continuously for fourteen hours.

In addition to the survey work of the expedition, the party observed the direction and pace of upper air currents, as indicated by the movement of cirrus clouds, collected zoological and botanical specimens, and remeasured the snouts of certain glaciers which had previously been marked by the late Sir Henry Hayden of the Geological Survey of India.

The Surveyor General has conveyed his hearty congratulations and sincere thanks to all members of the Netherlands Expedition for their success in making this valuable contribution to Himalayan geography in the face of very great physical difficulties and considerable danger. The leader of the Expedition has expressed his very high appreciation of the energy, courage, and skill, displayed by Khan Sahib Afraz Gul, and has strongly recommended him for any special promotion or reward which may be considered suitable.

APPENDIX.

The Services of Khan Bahadur Sher Jang.

By the retirement of Khan Bahadur Sher Jang on 15th June 1925 the Department has lost a most distinguished officer of the Upper Subordinate Service, who has been employed almost continuously, during his service of over 30 years in the Department, either on or beyond the Frontiers of India.

Sher Jang enlisted in Cook's Rifles in 1887. After taking part in the 1st and 2nd Mīrānzai Expeditions of 1890-91 and accompanying the Kurram Column in 1892-93, he joined the Survey of India as a Soldier-Surveyor in 1895. From 1895 to 1899 he served on the N. W. Frontier, taking part in the Waziristān Expedition of 1894-95, in the Tochi, Tīrāh and Mohmand Expeditions of 1897-98, and in Dīr and Chitrāl in 1899, when he was granted the title of Khan Sahib. From 1899 to 1901 he served with Captain Crookshank in Persia, visiting Bandar Abbās, Kermān, Shīrāz and Būshire, and surveying an area of about 53,000 square miles. In 1901-02 he was attached to the Abyssinian Boundary Commission and was awarded the title of Khan Bahadur at the early age of 32. In 1903-04 he accompanied the Tibet Mission, being mentioned in despatches, and in 1905-06 served under the Foreign Department in the Persian Gulf, visiting Būshire, Muhammareh, Basrah and the Masqāt frontier. He returned to South Persia in 1907-08 where he surveyed an area of some 25,000 square miles and travelled as far north as the frontier by Herāt. He was employed on the Baluchistān-Afghān frontier in 1909 and with the Afghān Mission in 1910, when he was awarded the McGregor Memorial Medal. He served with the Abor Expedition in 1911-12, when he was again mentioned in despatches, and with the Turco-Persian Boundary Commission in 1913-14, for which he was awarded decorations by the Persian and Turkish Governments.

When the Great War broke out in 1914, Khan Bahadur Sher Jang was engaged on survey work with this Commission in the neighbourhood of Urūmieh. He brought the survey personnel back through Persia by way of Miāneh, Tehrān, Qum, Isfahān, and Shīrāz, to Būshire. After a short period of service in India, Sher Jang returned to Persia, and in 1916-17 was with the party surveying the road alignment between Bandar Abbās and Kermān. In 1917-18, he

served in Waziristān and on the Mahsūd frontier, and towards the end of the latter year proceeded again to Mesopotamia. Owing to his intimate knowledge of conditions in Persian Kurdistān, he was now employed under the Political authorities on an important diplomatic mission.

At this time the tribes of Central Kurdistān were in an appalling condition of destitution, as the result of the war, and their chieftains were seeking the protection of the British. In the north, Sayyid Taha, who was in a position to control the tribes under British administration, had been invited to meet the Political Officer; but, being influenced by Turkish propaganda, had so far remained aloof. Khan Bahadur Sher Jang received orders to go to Urūmieh, and to negotiate with Sayyid Taha. He left Rowandūz with four Indian khalasis on 9th March 1919, forced a way over the snow-bound Guru-i-Shaikh pass on the Persian frontier, traversed the desolate Lāhijān country, and reached Urūmieh after much hardship on 20th March. Sayyid Taha was six stages away at Chahari, and owing to the attitude of the Persian Governor, Sher Jang was unable to leave Urūmieh. He wrote a letter to the Sayyid, persuading the latter to visit him in Urūmieh, and they met five days later. All through the night of the 25th March, the two men discussed the situation, and at last as dawn was breaking, Sher Jang won his case and prevailed upon Sayyid Taha to accompany him back to Baghdād. The success of this mission had a large share in maintaining tranquillity in the Rowandūz district during the subsequent rising of Shaikh Mahmud in Southern Kurdistān.

During this rebellion, Sher Jang served as a political officer in the Sulaimāni area. In 1920-21 he was appointed representative of 'Iraq in the re-settlement of the 'Iraq-Persian frontier, which had been disturbed by war conditions. His work in this connection was highly appreciated by the Right Hon. Mr. Winston Churchill, Secretary of State for the Colonies, in his despatch dated 21st September 1921. He returned to Persia in 1923 with a detachment of the Survey of India which was employed in survey work for the Anglo-Persian Oil Company.

The Khan Bahadur was promoted to the Upper Subordinate Service on 1st August 1909. He is in possession of 12 war medals and decorations, with 8 clasps; he has been awarded honoraria for his services on several occasions, and has received an assignment of land revenue from the Government of India. In 1902 the Royal Geographical Society

awarded him a Sword of Honour (the Back Memorial) in recognition of his valuable services to geography, and in 1916 he was awarded the Kaiser-i-Hind medal (2nd class). During the visit of H. R. H. the Prince of Wales to India in 1922, Sher Jang had the honour of being personally presented to His Royal Highness, who evinced a keen interest in his services.

Khan Bahadur Sher Jang's unfailing tact and courtesy endeared him to all with whom he came in contact, and it was largely these qualities in conjunction with his energy and resource in hazardous situations which rendered his work so successful and his services so valuable, politically and professionally, in the turbulent countries where so much of his life was passed.

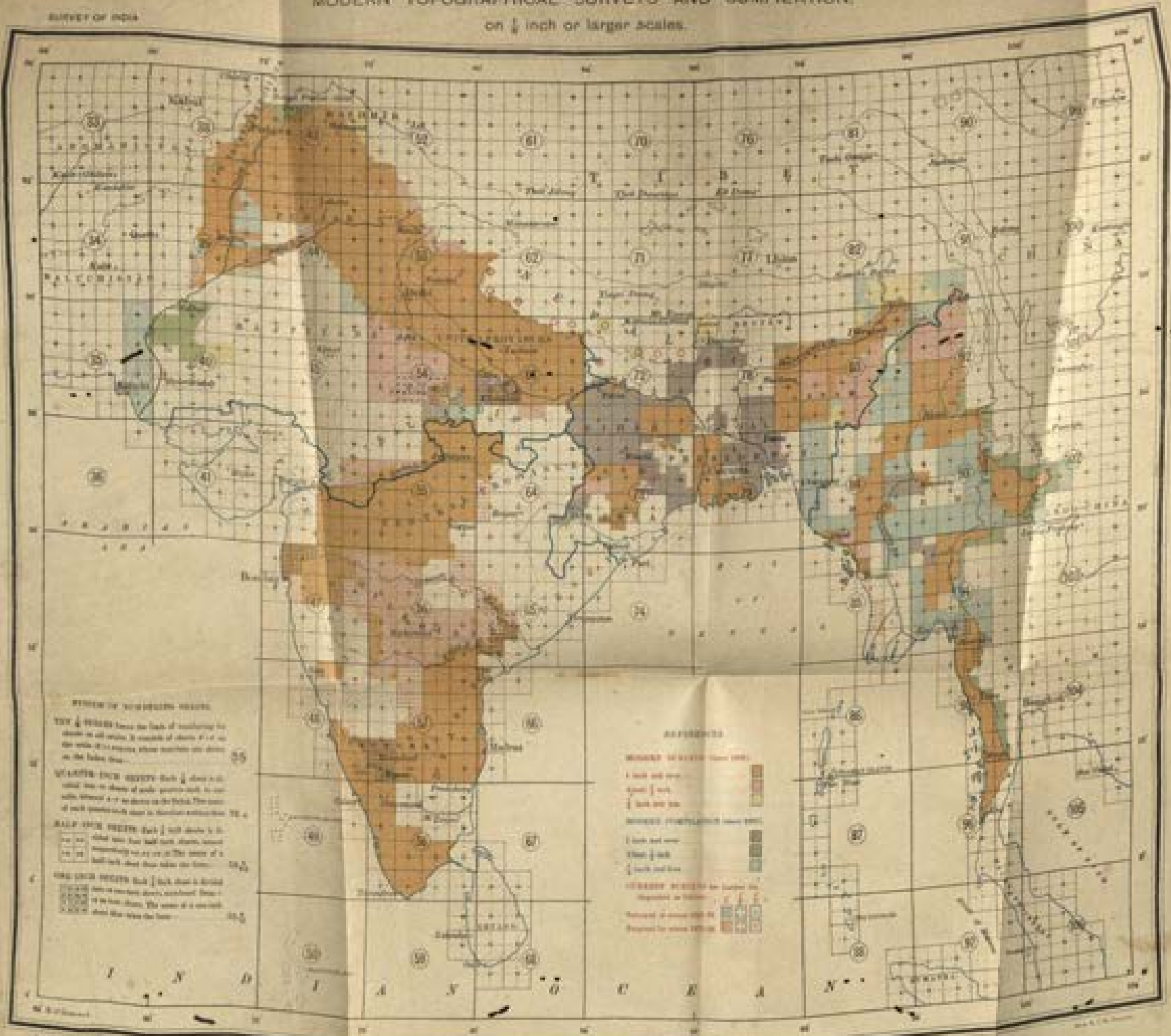
There was also another fine side of Sher Jang's character which was only realised by those who knew him well, namely his compassion for the weak. When he was on sick leave at the end of 1918, the virulent epidemic of influenza was ravaging the homes in his country. Sher Jang devoted his three months hard-earned rest to nursing the sick and burying the dead; and he has recorded in a letter, that he "regarded this duty greater than his active service". On another occasion, in Urūmieh in 1919, when he was by no means in a pleasant situation himself, he exercised all his personal influence in urging the protection of the hapless Christian women and children, whose lives were at that time threatened by fanatical Kurds.

It is not easy to summarise such varied services in a brief note of appreciation. Sher Jang succeeded in winning the admiration and affection of all officers with whom he served, both in the Survey of India and outside it, and he carries with him the best wishes of all ranks of the Department on his retirement.

SURVEY OF INDIA

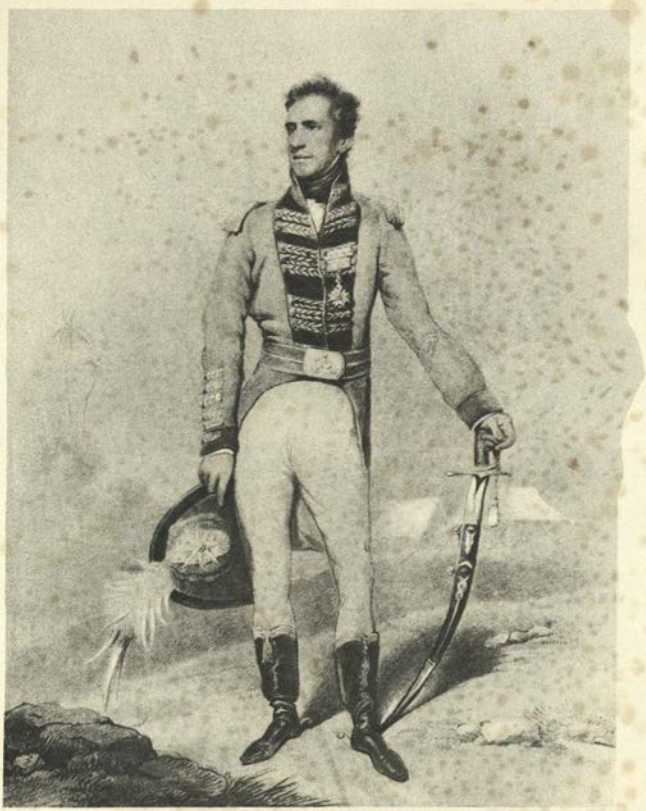
MODERN TOPOGRAPHICAL SURVEYS AND COMPILATION

on $\frac{1}{4}$ inch or larger scales.



MODERN TOPOGRAPHICAL SURVEYS AND COMPIL

on $\frac{1}{2}$ inch or larger scales.



Photogravure Survey of India Offices, Calcutta, 1913.

COLONEL VALENTINE BLACKER, C. B.

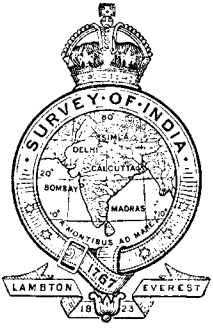
THE FIRST SURVEYOR GENERAL OF INDIA, 1823–1826.

(Died in Calcutta 1826. Vide Appendix.)

SURVEY OF INDIA

GENERAL REPORT

1925 TO 1926



From 1st October 1925
To 30th September 1926.

PUBLISHED BY ORDER OF

Colonel C. P. GUNTER, O.B.E., R.E.,

Offg. SURVEYOR GENERAL OF INDIA.

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1926.

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LIST OF PROVINCES AND STATES IN EACH CIRCLE.

Director, Frontier Circle, headquarters Simla, (telegrams "Surfrontier")—N.W. Frontier Province, Baluchistān, Kashmīr, Punjab, Punjab States, Delhi, Bīkaner and States of Western Rājputāna, Sind and Cutch.

Director, Central Circle, headquarters Mussoorie, (telegrams "Surcent")—United Provinces, Central Provinces, Central India Agency, Gwalior State, Baroda State, Ajmer and Eastern Rājputāna, Northern Division Bombay Presidency, States of Western India (less Cutch).

Director, Southern Circle, headquarters Bangalore, (telegrams "Sursouth")—Bombay Presidency (less Northern Division and Sind), Hyderābād and Mysore States, Coorg, Madras Presidency and Madras States.

Director, Eastern Circle, headquarters Shillong, (telegrams "Sureast")—Bihār and Orissa, Bengal Presidency, Assam and Sikkim.

Director, Burma Circle, headquarters Maymyo, (telegrams "Surburma")—Burma, the Andaman and Nicobar Islands.

HOW WE CAN HELP YOU.

Surveys of every kind can be carried out for private firms as well as for all Government Departments on application to the following Survey Directors:—

The Director, Frontier Circle, Survey of India, Simla. (*Telegrams "Surfrontier"*).

The Director, Central Circle, Survey of India, Mussoorie (*Telegrams "Surcent"*).

The Director, Southern Circle, Survey of India, Bangalore. (*Telegrams "Sursouth"*).

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The Director, Burma Circle, Survey of India, Maymyo. (*Telegrams "Surburma"*).

Triangulation, Levelling, Cantonment Surveys, Tide Tables. Advice in regard to these, and on scientific questions, is obtainable from the *Director, Geodetic Branch*, Survey of India, Dehra Dūn, who also undertakes a good deal of levelling and similar work on payment. (*Telegrams "Surtrig"*).

Maps and Illustrations can be printed by the *Director, Map Publication*, Survey of India, 13 Wood Street, Calcutta, for government departments only, and special maps can also sometimes be prepared, on payment. (*Telegrams "Surpub"*).

The Mathematical Instrument Office, Survey of India, 15 Wood Street, Calcutta, supplies and repairs all kinds of optical and surveying instruments, and takes back surplus instruments, on valuation, from all government departments, whether Imperial or Provincial. (*Telegrams "Surinst"*).

General enquiries should be addressed to the Assistant Surveyor General, 13, Wood Street, Calcutta, (*Telegrams "Suroffice"*), as the Surveyor General of India (*Telegrams "Surveys"*) is on tour during most of the year.

HOW TO OBTAIN MAPS AND OTHER SURVEY PUBLICATIONS.

Maps. The Map Record and Issue Office, Survey of India, 13 Wood Street, Calcutta, (*Telegrams "Surmaps"*) can supply maps, on a great variety of scales, for all parts of India and most of Southern Asia. These are also obtainable to some extent, from the Agents detailed on page v and from the Directors of Circles detailed in the notice on page ii.

A Catalogue of Maps, showing Survey of India maps available for all Southern Asia, and itself forming a useful atlas of the Indian Empire, is obtainable from the above, at the cost of *One Rupee only.*

Forest Maps are obtainable only from the Forest Map Office, Survey of India, Dehra Dūn. (*Telegrams "Surforest"*).

Geological Maps are obtainable from the Director, Geological Survey of India, Calcutta.

Publications. An abstract of professional publications, other than maps, is given overleaf, and a complete list of these is obtainable *gratis*, from the Director, Geodetic Branch, Survey of India, Dehra Dūn. (*Telegrams "Surtrig"*).

ABSTRACT OF PUBLICATIONS.

Survey of India Publications other than maps may be divided into—

(A) Historical and General Reports
(B) Geodetic works of reference
(C) Catalogues, Instructional handbooks, etc.
(D) Miscellaneous papers.

Historical and General Reports include the Memoirs by Sir Clements Markham and by C. E. D. Black, the Annual General Reports, Narrative Reports, Records Volumes, etc.

Geodetic works of reference comprise Everest's Great Arc Books, the G. T. S. Volumes, Triangulation and Levelling Pamphlets, and Tide Tables for various ports between Suez and Singapore.

The G. T. S. Volumes form a series of nineteen volumes, describing in detail the various operations of the Great Trigonometrical Survey. Detailed accounts are given of Base-line measurements, of the reduction of Principal Triangulation with each main figure treated separately, of Telegraphic Longitude and Astronomical Latitude operations and of Levelling of high precision.

Catalogues, Instructional handbooks, etc., comprise Departmental Orders, Catalogues and Lists, Tables and Star Charts, Manuals, Handbooks, etc.

Miscellaneous papers include various unclassified papers on Geography, Geodesy, Exploration, etc., and other professional and departmental papers and forms.

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SURVEY OF INDIA

GENERAL REPORT

1925 TO 1926

From 1st October 1925
To 30th September 1926

INTRODUCTION AND SUMMARY.

1. **Annual Reports.**—Annual Reports are now published in three separate volumes as follows:—

General Report.
Geodetic Report.
Map Publication and Office Work Report.

The first two are for the survey year ending 30th September but the last is for the financial year up to 31st March.

The Map Publication Report contains *all the index maps* showing the progress of map publication on all scales, with reports on publication and issue, printing and drawing, and of such offices as the Mathematical Instrument Office, which have to conform with the financial year.

The Geodetic Report includes full details of all scientific work.

This General Report only gives brief abstracts of the above (*vide* Abstracts IV and V in the Table of contents) and is confined to reporting the survey operations of the ordinary field parties and detachments. The first three Abstracts (*vide* Table of contents) summarise these reports and enable the reader to look up such portions as may concern him. There are three index maps at the end, showing the progress of modern topographical surveys, compilation and publication. Maps of sorts are of course available for all parts of the Indian Empire, but some are very old, and all previous to 1905 were based on the old longitude of 1815, (which was over 2 miles out), and are excluded from the index maps.

2. **General.** Colonel Commandant E. A. Tandy, R.E., the Surveyor General, proceeded on 8 months and 3 days leave from the 15th March 1926. Colonel C. P. Gunter, O.B.E., R.E., was appointed Officiating Surveyor General during his absence on leave.

The total area of new surveys of all kinds completed during the year was 42,489 square miles.

3. *The total cost* of the Department for the past financial year ending 31st March 1926, as compared with that of previous years, was as follows:—

	1923-24.	1924-25.	1925-26.	REMARKS.
	Rs.	*Rs.*	*Rs.*	
Gross actual cost ...	51,14,799	53,66,784	53,37,235*	* These figures are not final.
Deduct receipts and credits	21,15,470	22,27,138	21,82,240*	
Net actual charges ...	29,99,329	31,39,646	31,54,995*	

4. *Organization.—Formation of Frontier Circle.*—Under the orders of the Government of India, a new circle of the Survey of India designated the Frontier Circle and comprising roughly the area of the Northern and Western Commands of the Army was constituted with effect from the forenoon of 1st October 1925 with head-quarters at Simla. Colonel C. P. Gunter, O.B.E., R.E., who held the temporary post of Director Frontier Surveys from 27th April 1925, was appointed Director Frontier Circle. The following survey units were placed under the administrative control of the Director Frontier Circle:— Nos. 2, 3 (now E and A Companies), 18 and 19 Parties, No. 6 Drawing Office (Simla), the Settlement Survey Detachment from 1st October 1925, and No. 23 Party from 1st July 1926. No. 19 Party was temporarily transferred to the administrative control of the Director Geodetic Branch with effect from 12th April 1926.

As a result of the formation of the Frontier Circle, it was considered desirable, when redistributing the circle areas, to make them correspond with administrative boundaries and to notify them in order that survey records may be stored in the proper circle head-quarters and that civil administrations may know which Director to address on survey matters. The Survey of India was accordingly divided into five circles from 1st April 1926, as shown in the index maps at the end of the book.

A list of provinces and states comprised in each circle is given in Notice No. 1.

5. Notable events of the survey year were as follows:—

(*a*) The Netherlands Exploration Party under Mr. P. C. Visser, which was exploring in Hunza Valley, as mentioned in last year's report, and to which Khan Sahib Afraz Gul Khan of the Survey of India was

attached, closed work in October 1926. The total area surveyed by the Khan Sahib was 2,580 sq. miles on the scale $\frac{1}{2}$" = 1 mile.

(*b*) Surveyor Torabaz Khan was deputed to accompany Sir Aurel Stein in his archæological expedition to the Upper Swāt Valley.

(*c*) Under the orders of the Government of India a party consisting of three Upper Subordinate officers and nine surveyors under Mr. J. McCraken, M.B.E., was deputed to foreign service to carry out survey work on behalf of the Turkish Petroleum Co., Ltd., Baghdād. The party sailed from Bombay on the 23rd October 1925 and returned to India in July 1926. The manager of the company has expressed high commendation of the behaviour and conduct of the party, which is reported to have been exemplary. Mr. Sajawal Khan's local experience and influence proved of great value to the party.

(*d*) The assistance rendered by Messrs. K. K. Das, B.A., and H. C. Banerjea, B.A., in a gravity survey with the Eotvos torsion balance in Assam was greatly appreciated by Dr. Pakar, the Hungarian scientist of the Burma Oil Co., Ltd.

(*e*) A lecture was delivered at Poona in May 1926, on "Survey and Maps", to the Intelligence Class by Lt.-Col. C. M. Browne, C.M.G., D.S.O., R.E.

(*f*) *Air survey.*—The Government of Burma (Ministry of Forests) has conveyed its thanks to Major C. G. Lewis, R.E., for his work while in charge of the Aero-photo party that was responsible for the survey of the Irrawaddy Delta in the following terms—"The Ministry realises how much the success of this work was due to the efficiency of ground control in featureless country for which Major Lewis was responsible and later to his skill in interpreting the results of the photography".

(*g*) With a view to study the latest processes in aero-photo work, Major C. G. Lewis, R.E., was given permission while on leave in England to visit firms in England and Switzerland as well as the Swiss Federal Topographical offices.

6. Personnel.—Casualties, retirements, recruitments, and awards were as follows:—

Class I officers:—Lt.-Col. H. J. Couchman, D.S.O., M.C., R.E., was transferred temporarily to the Security Printing, Nāsik, as Deputy Master from 28th April 1926.

Mr. S. S. McA'F. Fielding was temporarily promoted from Class II to Class I service.

Lieuts. H. W. Wright, R.E., and I. M. Cadell, R.E., were appointed to the Department.

Mr. Behari Lal Gulatee, B.A., (Cantab), Assistant Research Officer, Irrigation Department, Punjab, was appointed on probation as Asstt. Mathematical Adviser outside the Class I cadre.

Class II officers.—Messrs. G. J. S. Rae and J. H. S. Wilson retired.

Seven candidates were appointed to Class II service on the result of the examination referred to in last year's report.

Mr. H. H. Creed was transferred to the Bengal Survey Department for a period of 5 years.

Upper Subordinate officers.—Messrs. Muhammad Khan, Shaikh Muhammad Salik and Shaikh Subhan retired.

Mr. Paras Ram died. Four Lower Subordinates were promoted to the Upper Subordinate service and three Upper Subordinate probationers were discharged.

Awards.—Major K. Mason, M.C., R.E., was awarded the "Cuthbert Peek Grant" of the Royal Geographical Society to assist him in further explorations of the Himālayas.

Khan Sahib Afraz Gul Khan received the award of the "Back Grant" of the Royal Geographical Society for his surveys in Central Asia and Hunza.

The following honours were conferred during the year:—

Khan Bahadur	... Khan Sahib Saiyid Zille Hasnain, Extra Assistant Superintendent, Survey of India, (Retired).
Rai Sahib	... Mr. Chuni Lal Kapur, Extra Assistant Superintendent.
	Mr. Sarada Charan Chakrabarti, Head Assistant, Map Publication Office.
Khan Sahib	... Mr. Abdul Latif Khan, Sub-Assistant Superintendent.

I.—ABSTRACT OF SURVEYS IN EACH PROVINCE AND STATE.

(*For Abstract of Forest and Cantonment Surveys, see Part III, page 13*).

7. Central Circle.

Punjab.—Riverain surveys, Jhelum, Miānwāli, Lyallpur, Montgomery and Shekhūpura districts, (p. 28). Boundary survey, Ambāla district and Sirmūr State, (p. 29). Rectangulation, Ferozepore district, (p. 30) and four inch survey, Ferozepore, Lahore, Montgomery and Muzaffargarh districts for Sutlej Valley Irrigation Project, (p. 29).

United Provinces.—Topographical surveys, Jhānsi district, (p. 27), Bāndā, Cawnpore, Fatehpur and Hamirpur districts, (p. 26). Four inch contoured survey, Morādābād and Sahāranpur districts for East Indian Railway, (p. 25). Forest Boundary demarcation, Bahraich and Kheri districts, (p. 25). Large scale survey, Muttra City, (p. 29).

Central India.—Baghelkhand Agency. Topographical surveys, Baraundā State and Chaube Jāgirs, (p. 26).

Bundelkhnd Aagency.—Topographical surveys, Ajaigarh, Baoni, Beri, Charkhāri, Chhatarpur and Gaurihar States, (p. 26), Orchhā State, (p. 28).

Central Provinces.—Topographical surveys, Bālāghāt, Bhandāra, Mandlā and Seoni districts, (p. 27). Forest surveys, (p. 27). Cantonment survey of Pachmarhi, (p. 48).

Gwalior State.—Topographical surveys, (p. 28).

8. Frontier Circle.

North-West Frontier Province.—Revision topographical surveys, Peshāwar and Hazāra districts and topographical surveys, Swāt and Buner, (pp. 31, 32). Air survey for cadastral maps, Peshāwar district, (p. 34). Air survey of river Indus, (p. 34). Settlement survey, Peshāwar district, (p. 36).

Punjab.—Revision topographical surveys, Attock and Rāwalpindi districts, (p. 31). Air survey for cadastral maps, Attock district, (pp. 34, 36). Air survey of river Indus, (p. 34). Settlement survey, Attock district, (p. 36).

Sind.—Topographical surveys, Hyderābād and Karāchi districts, (p. 33). Mosaic of river Indus, Hyderābād district, (p. 34).

Baluchistān.—Topographical surveys, Las Bela State, (p. 33).

9. Southern Circle.

Central Provinces.—Topographical surveys, Chānda district and Bastar State, (p. 37).

Bombay.—Topographical surveys, Ahmadnagar, Sholāpur, Thāna, Kolāba, Poona and Ratnāgiri districts, (p. 38). Forest surveys, (p. 39).

Bombay States.—Topographical surveys, Bhor, Janjira, Sāngli, Mirāj (Senior) and Mirāj (Junior) States, (p. 38).

Hyderābād State.—Topographical surveys, Warangal, Karimnagar, Adilābād, Raichūr, Bhir and Osmānābād districts, (pp. 37, 38).

Madras.—Topographical surveys, East Godāvari, Anantapur, Bellary, Cuddapah and Kurnool districts, (pp. 37, 38). Four inch survey, Salem and Coimbatore districts, for Cauvery (Mettūr) project, (p. 38).

10. Eastern Circle.

Assam.—Topographical surveys, Sadiyā Frontier Tract, Lakhimpur district and tribal area, (p. 42). Forest surveys, (p. 42).

Bihār and Orissa.—Topographical surveys, Hazāribāgh, Singhbhūm, Mānbhūm and Cuttack districts, Keonjhar, Dhenkānāl, Saraikelā and Mayūrbhanj States, (pp. 40, 41). Four inch surveys, Jharia coalfield, Mānbhūm and Hazāribāgh districts, (p. 41). Forest Surveys, (p. 41).

11. Burma Circle.

Topographical surveys, Sandoway, Henzada, Bassein and Myaungmya districts and tribal area known as "The Triangle", (p. 44), Amherst and Thaton districts, (p. 45). Maymyo Guide Map, (p. 44). Moulmein Guide Map, (p. 45). Forest surveys, (pp. 44 to 47).

II.—ABSTRACT OF TOPOGRAPHICAL WORK.

12. The following two tables show respectively the progress of the topographical programme assigned to the Department in 1905 and the out-turns and cost-rates of different parties during the year under report. In 1913 the Secretary of State sanctioned a scheme for the reduction of the scale of survey of certain sparsely populated areas of India. This will greatly reduce the area of survey on the scale 1 inch = 1 mile and consequently accelerate the rate of progress of topographical surveys shown in Table I below. In order to give a better idea of what work actually lies before the Department, it may be remarked that of the area remaining for survey about 489,000 square miles may possibly be surveyed on the scale ½ inch = 1 mile or smaller scales. There is however at present a tendency to revert to the larger scale in many areas, owing to the pressing requirements of geologists and engineers, and to the military demand for maps on a larger scale.

Table I.—Progress of Topographical Surveys since 1905.

Survey year.	Scales of survey.	Central Circle.	Frontier Circle.	Southern Circle.	Eastern Circle.	Burma Circle.	TOTALS.
	Mostly	*Sq. miles.*	*Sq. miles.*	*Sq. miles.*	*Sq. miles.*	*Sq. miles.*	*Sq. miles.*
1905-14	1 & ½ inch = 1 mile.	175,408		96,154	34,842	64,641	371,045
1914-15	ditto.	12,334		19,286	2,448	2,608	36,676
1915-16	ditto.	8,168		17,243	2,279	4,652	32,342
1916-17	ditto.	11,689	Areas included under Central Circle.	11,338	3,560	6,163	32,750
1917-18	ditto.	4,202		12,181	3,596	4,800	24,779
1918-19	ditto.	509		7,263	1,764	4,412	13,948
1919-20	ditto.	9,145		11,891	4,311	5,117	30,464
1920-21	ditto.	14,411		14,275	5,766	5,509	39,961
1921-22	ditto.	11,528		21,596	5,970	5,510	44,604
1922-23	ditto.	26,199		20,823	9,144	5,482	61,648
1923-24	ditto.	18,544		28,160	11,363	7,606	65,673
1924-25	ditto.	12,095		21,765	4,544	5,913	44,317
Completed up to 1924-25.		304,232*		281,975	89,587	122,413	798,207
†As redistributed 1925-26.		213,774	172,382	200,051	89,587	122,413	798,207
1925-26	ditto.	11,621	4,906	14,137	6,029	5,796	42,489
Areas completed		225,395	177,288	214,188	95,616	128,209	840,696
Balance remaining		212,605	354,327	129,362	189,619	137,666	1,023,579
Total programme		438,000	531,615	343,550	285,235	265,875	1,864,275‡

* Detailed areas shown under Central Circle up to 1924-25 were surveyed under the Northern Circle.

† The Northern and Southern Circles having been re-arranged as Central, Frontier and Southern, the total areas surveyed up to 1924-25 are given as now redistributed, the details for each year being left undisturbed.

‡ Advantage has been taken of the opportunity afforded by the re-arrangement of the Circles to calculate more accurately the area covered by the programme. The total arrived at is 1,864,275 square miles as against 1,821,600 sq. miles shown in previous reports.

Table II.—OUT-TURNS of PLANE-TABLING and COSTS of Topographical Surveys, 1925-26.

Party and Locality. Character of country.	Scale and class of survey.	Out-turns of Plane-tabling. Areas on each scale of each class.	Out-turns of Plane-tabling. Totals of areas on all scales.	Costs of Survey including Mapping. Total costs.	Costs of Survey including Mapping. Cost-rates.	Remarks.
		Sq. miles.		*Rs.*	*Rs. per sq. mile.*	
						CENTRAL CIRCLE.
No. 1 Party—*United Provinces and Central India.*						
Cultivated plains, congested with villages, and low hills densely wooded.	One inch Resurvey ...	536	3,222	67,874	21·1	
	One inch Revision survey ...	2,686				
No. 5 Party—*Central Provinces.*						
Jungle-clad hills and cultivated plains.	One inch Original survey ...	2,175	2,847	51,168	17·9	
	One inch Supplementary survey	671				
	Four inch Original survey ...	1				
Jhansi Survey Detachment—*United Provinces, Central India and Gwalior State.*						
Dense jungle-clad hills; undulating plains, partly cultivated and partly covered with thorny scrub.	One inch Original survey ...	1,562	2,751	95,259	34·6	
	One inch Resurvey ...	185				
	One inch Revision survey ...	1,004				
TOTALS, CENTRAL CIRCLE:— 8,820† sq. m. Rs. 2,14,301 Cost-rate 24·3						

†In Table I, an area of 192 square miles, previously surveyed, is excluded, and an area of 2,993 square miles surveyed by No. 6 Party of the Southern Circle but falling in the area of the Central Circle is included.

Table II.—OUT-TURNS of PLANE-TABLING and COSTS of Topographical Surveys, 1925-26.

Party and Locality. Character of country.	Scale and class of survey	Out-turns of Plane-tabling. Areas on each scale of each class.	Out-turns of Plane-tabling. Totals of areas on all scales.	Costs of Survey including Mapping. Total costs.	Costs of Survey including Mapping. Cost-rates.	Remarks.
		Sq. miles.		*Rs.*	*Rs. per sq. mile.*	
						FRONTIER CIRCLE.
A. Survey Company—*North-West Frontier Province and Punjab.*						
Medium hills, bare in foot hills and wooded in higher hills.	One inch Original survey ...	774				
Cultivated plains and low hills, partly wooded.	One and a half inch Original survey ...	70	2,807	(b) 1,07,953	38·5	(a) Excludes 774 sq. miles surveyed in hot weather 1926, of which fair-mapping has not commenced.
	One and a half inch Resurvey ...	485				
	One and a half inch Revision survey ...	2,252				(b) Excludes Rs. 8,000 cost of fair-drawing No. 18 Party's work, Rs. 1,455 cost of exploration, Rs. 34,084 cost of advance triangulation, Rs. 398 miscellaneous Army Dept. work, Rs. 296 debitable to Murree Municipality and Rs. 22,429 cost of work in Buner, not yet fair-mapped.
E. Survey Company—*Baluchistān (Las Bela State) and Sind Province.*						
Open desert, low hills and coast line.	One and a half inch Original survey ...	300				
Open desert, low hills and coast line.	Two inch Resurvey ...	727	2,099	(c) 1,84,856	88·1	(c) Includes Rs. 76,924 cost of training probationers, etc.
Open desert, scrub covered desert, low hills and coast line.	One and a half inch Resurvey ...	1,072				
TOTALS, Frontier Circle:—4,906 sq. m. Rs. 2,92,809 Cost-rate 59·7						

Table II.—OUT-TURNS of PLANE-TABLING and COSTS of Topographical Surveys, 1925-26.

Party and Locality. Character of country.	Scale and class of survey.	Out-turns of Plane-tabling. Areas on each scale of each class.	Out-turns of Plane-tabling. Totals of areas on all scales.	Costs of Survey including Mapping. Total costs.	Costs of Survey including Mapping. Cost-rates.	Remarks.
		Sq. miles.		*Rs.*	*Rs. per sq. mile.*	
No. 6 Party—*Central Provinces, Hyderābād State and Madras.*						**SOUTHERN CIRCLE.**
Dense forest-clad hills with few open patches of cultivated areas near the main rivers like the Godāvari, Indrāvati and Prānhita.	One inch Original survey ...	5,020	6,666	1,53,503	23·0	
	One inch Revision survey ...	512				
	One and a half inch Revision survey ...	1,134				
No. 7 Party—*Hyderābād State and Madras.*						
Open plains of "black cotton" soil, with intricate rocky outcrops.	One inch Original survey ...	4,588	5,809	*(a)* 78,884	*(b)* 13·7	*(a)* Excludes Rs. 505 recoverd from Army funds and Rs. 24,000 recoverable from Government of Madras.
	One inch Supplementary survey	1,152				*(b)* 69 square miles surveyed for Government of Madras excluded in calculating cost rate.
	Four inch Original survey ...	69				
No. 8 Party—*Bombay and Hyderābād State.*						
Thickly populated coastal areas heavily wooded hills, and undulating plains mostly under cultivation.	One inch Revision survey ...	5,328	7,059	*(c)* & *(d)* 1,40,342	19·8	*(c)* Includes Rs. 11,486 debitable to Forest Department, Bombay.
	One inch Original survey ...	49				*(d)* Excludes cost of 4-inch and 8-inch mapping.
	One inch Original survey ...	1,633				
	Four inch Original survey ...	47				
	Eight inch Original survey ...	2				
TOTALS, SOUTHERN CIRCLE:—		19,534† sq. m.		Rs. 3,72,729	Cost-rate 19·0	

† Area of 14,137 square miles shown in Table I, excludes 1,134, 1,152, 47 & 2 square miles previously surveyed, and 69 square miles, which is a special contribution work for the Government of Madras, and 2,993 square miles of the Central Circle area surveyed by No. 6 Party.

Table II.—OUT-TURNS of PLANE-TABLING and COSTS of Topographical Surveys, 1925-26.

Party and Locality. Character of country.	Scale and class of survey.	Out-turns of Plane-tabling. Areas on each scale of each class. (Sq. miles.)	Out-turns of Plane-tabling. Totals of areas on all scales. (Sq. miles.)	Costs of Survey including Mapping. Total costs. (Rs.)	Costs of Survey including Mapping. Cost-rates. (Rs. per sq. mile.)	Remarks.
No. 4 Party—*Bihār and Orissa.—(Jharia coalfield.)*						EASTERN CIRCLE.
Undulating country, cut up by the Dāmodar and Jamuniā rivers, congested with buildings, both new and disused colliery workings and many lines of railways.	Four inch Supplementary survey with 10-foot contours.	249	699	1,10,450 (a)	158·0	(a) Excludes Rs. 17,496 cost of triangulation done in advance for next year and includes Rs. 12,308 out of Rs. 18,462 cost of triangulation done last year, leaving a balance of Rs. 6,154 to be adjusted in a subsiquent report.
Steep wooded hills surrounded by cultivated undulating country.	One inch Original survey ...	109				
	One inch Supplementary survey	341				
No. 9 Party—*Bihār & Orissa.*						
High wooded hills, open and cultivated undulating country dotted with low scrub-covered hills.	One inch Original survey ...	1,805	2,754	1,12,119	40·7	
	One inch Supplementary survey	949				
Sadiyā Frontier Detachment—*Assam.*						
High hills and low plains, all densely wooded plains intersected by the Luhit, Dihing and Tirāp rivers.	One inch Original survey ...	1,913	2,576	1,84,779 (b)	71·7	(b) Includes Rs. 34,972 cost of triangulation, etc., in advance from last year and excludes Rs. 22,572 cost of triangulation etc., in advance for survey next year.
	Half inch Original survey ...	663				
No. 12 Party—*Assam.*						
This party did not take the field but was employed on drawing of 10-mile Guide Maps of Eastern Circle.	... ...					1,484 sq. miles were also mapped in addition to 2,576 sq. miles surveyed during the year.
TOTALS, EASTERN CIRCLE:— 6,029 sq. m. Rs. 4,07,348					**Cost-rate 67·5**	

Table II.—OUT-TURNS of PLANE-TABLING and COSTS of Topographical Surveys, 1925-26.

Party and Locality. Character of country.	Scale and class of survey.	Out-turns of Plane-tabling. Areas on each scale of each class.	Out-turns of Plane-tabling. Totals of areas on all scales.	Costs of Survey including Mapping. Total costs.	Costs of Survey including Mapping. Cost-rates.	Remarks.
		Sq. miles.		*Rs.*	*Rs. per sq. mile.*	
No. 10 Party—*Burma.*						**BURMA CIRCLE.**
Wooded hills	Half inch Original survey ...	338				(*a*) Includes 25 sq. miles special forest survey.
Densely wooded hills, creeks, islands, and mangrove swamps.	One inch Original survey ...	2,067				(*b*) 18 sq. miles special forest survey.
Open cultivated plains, creeks and low hills.	One inch Revision survey ...	344				(*c*) 25 sq. miles special forest survey.
High densely wooded hills and open cultivated plains, intersected by creeks.	One inch Supplementary survey	462	**3,315**	2,18,601 (*f*)	**65·9**	(*d*) 128 sq. miles special forest survey. (*e*) 260 sq. miles special forest survey. (*f*) Includes Rs. 9,522 debitable to the Forest Department, Burma.
Densely wooded hills ...	Two inch Original survey ...	86(*a*)				(*g*) Includes Rs. 28,908 debitable to the Forest Department, Burma.
Thickly populated wooded plateau and wooded hills.	Four inch Original survey ...	18(*b*)				(*h*) The whole cost is debitable to the Forest Department, Burma.
No. 11 Party—*Burma.*						
High hills with evergreen forest and well wooded low ground varied with hills and scattered cultivation.	One inch Original survey ...	627				
Cultivated areas, thickly wooded low hills and plains.	One inch Supplementary survey	1,781	**2,549**	1,68,891 (*g*)	**66·3**	
Low hills and undulating ground thickly wooded.	Four inch Original survey ...	116				
Moulmein Guide Map ...	Four inch Original survey ...	25(*c*)				
No. 21 (Burma Forest) Party.						
Densely wooded hills and plains	Two inch Original survey ...	128(*d*)	**388**	1,85,304 (*h*)	**477·6**	
	Four inch Original survey ...	260(*e*)				
TOTALS, Burma Circle:— † 6,252 sq. m. Rs. 5,72,796 Cost-rate 91·6						
GRAND TOTALS:— 45,541 sq. m. Rs. 18,59,983 Cost-rate 40·8						

† In table I, 456 square miles of special forest surveys, as shown in Remarks column, are excluded.

III.—ABSTRACT OF FOREST, CANTONMENT, AND OTHER SPECIAL SURVEYS.

13. Forest Surveys.

United Provinces.—Eastern Forest Circle. Jhānsi Forest Divn., (p. 28). Bahraich Forest Divn., (p. 25).

Central Provinces.—Northern Forest Circle. Mandlā Forest Divn., Seoni Forest Divn., (p. 27).

Southern Forest Circle.—Bālāghāt Forest Divn., Bhandāra Forest Divn., (p. 27).

Sind.—Sind Forest Circle. Hyderābād and Karāchi Forest Divns., (p. 33).

Bombay.—Northern and Central Forest Circles. West Nāsik Forest Divn., (p. 39), Poona Forest Divn., (p. 39), Kolāba Forest Divn., (p. 39).

Assam.—Eastern Forest Circle. Sadiyā Forest Divn., (p. 42). Sibsāgar Forest Divn., (p. 42).

Bihār and Orissa.—Chaibāsa Forest Divn., (p. 41).

Burma.—Delta Forest Circle. Henzada-Ma-ubin Forest Divn., Bassein Forest Divn., (p. 44).

Federated Shan States Forest Circle.—Northern Shan States Forest Divn., (p. 44).

Tenasserim Forest Circle.—Thaton Forest Divn., (p. 45). Thaungyin Forest Divn., (p. 45).

Hlaing Forest Circle.—Allanmyo Forest Divn., Prome Forest Divn., (p. 46).

Sittang Forest Circle.—North Toungoo Forest Divn., North Pegu Forest Divn., (p. 46).

Central Forest Circle.—Magwe Forest Divn., Pyinmanā Forest Divn., Yamethin Forest Divn., Meiktila Forest Divn., (pp. 46-47).

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14. Cantonment and City Surveys, etc.

Geodetic Branch.—Campbellpore, Ferozepore, the *Galis* in Murree hills, Rāwalpindi, Quetta, Loralai, Fort Sandeman, Chaman, Lahore, Multān, (p. 48).

Central Circle.—Muttra, (p. 29). Pachmarhi, (p. 48).

Burma Circle.—Maymyo Guide Map, (p. 44), Moulmein Guide Map, (p. 45).

15. Special Surveys.

Punjab.—Riverain surveys, (p. 28).
Sutlej Valley Irrigation Project, (p. 29).
Ambāla-Sirmūr Boundary, (p. 29).
Punjab-United Provinces Boundary demarcation, (p. 28).

Central India.—Bhopāl surveys, (p. 49).

United Provinces.—Survey for railway flood protection, (p. 25).

Hyderābād State.—Survey of Sarangapalli-Tekmatla coal-field, (p. 37).
Revision survey on the scale 1½ inches = 1 mile of the country around Secunderābād for the military authorities, (p. 37).

Madras.—Survey of the Kistna Valley at Siddeswaram, (p. 37). Cauvery Mettūr survey, (p. 38).

Bombay.—Fixing points for 16th Field Brigade, Royal Artillery, Kirkee, (p. 39).

Sind.—Mohenjo-daro ruins. (p. 49).

Mysore.—Fixing points for 12th Field Brigade, Royal Artillery at Hoskote and Bangalore, (p. 39).

Bihār & Orissa.—Jharia coalfield survey, (p. 41).

IV.—ABSTRACT OF GEODETIC OPERATIONS.

DIRECTOR { Lt.-Colonel R. H. Thomas, D.S.O., R.E., from 1-10-25 to 27-11-25.
Lt.-Colonel M. O'C. Tandy, D.S.O., O.B.E., R.E., from 28-11-25.

16. *Organization.*—The Bhopāl Survey Detachment was transferred from the administrative control of the Director Central Circle, to that of the Director Geodetic Branch. No. 13 Party was transferred from the administrative control of the Director Geodetic Branch, to that of the Director Map Publication. No. 19 Party, which was transferred to the administrative control of the Director Frontier Circle, has been re-transferred temporarily to the control of the Director Geodetic Branch.

The designation of the Superintendent of the Trigonometrical Survey has been changed to the Director, Geodetic Branch.

The following parties and offices were administered by the Director, Geodetic Branch:—

Nos. 13, 14, 15, 16, 17, 19 and 20 Parties, Bhopāl Survey Detachment, Survey Training School, Computing and Tidal Party, No 2 Drawing Office and the Forest Map Office.

The work of No. 20 Party (Cantonment Section) is briefly described in part X (p. 48).

Full details of the following geodetic operations are being published in the Annual Report of the Geodetic Branch.

17. *Deflection and gravity observations.*—(Nos. 13 and 14 Parties). These parties did not take the field during 1925-26. The computation of observations made in Kashmir during the previous year was completed, except the computation of the Hayford anomalies. Preparations were made for the International Longitude Observations at Dehra Dūn in 1926.

18. *Triangulation.*—(No. 15 Party). In November 1925 Principal Triangulation was commenced in Lower Burma, to supply reliable fixed points round Rangoon on which to base a new large scale map of that town, proposed by the Local Government, and to assist the topographical survey of the area.

Previous triangulation in the area consisted of some minor work done in 1875. Many of the stations had disappeared and those remaining were not sufficiently reliable to be used.

The new series breaks off southwards from the Burma Coast Series 80 miles north of Rangoon and runs through the Government Reserved Forests of the Pegu Yoma hills. The reconnoitring and building of the

stations were completed as far as Rangoon, and the observations were started in February 1926, but, after the first two stations had been observed, thick haze made further work impossible.

19. *Tidal operations.*—Self-registering tide-gauges were operated at Aden, Basrah, Karāchi, Bombay, Madras, Kidderpore, Rangoon and Bassein.

Readings of the actual times and heights of high and low waters, taken on tide-poles during daylight only, were made at Bhāvnagar, Chittagong and Akyab under the supervision of the local Port Officers concerned, the results being sent to Dehra Dūn regularly every month.

Weekly charts of the tidal curves registered on the automatic tide-recorder at Ma'qil were received from Basrah each month, but these observations have not been reduced by the harmonic analysis method, as the values of the tidal constants deduced from the past nine years have been deemed sufficient.

The preparation and publication of the 1927 tide tables for Basrah and the Indian ports is expected to be completed early in October 1926.

Advance manuscript and printed copies of tide tables for 17 ports for 1927 were sent to the Admiralty by the end of March 1926 for inclusion in the Admiralty tide tables. The running off of the tidal curves for 1928 tide tables has been completed.

The tidal observatories at Bassein, Rangoon and Kidderpore were inspected in February 1926.

At the request of the Deputy Conservator to the Commissioners of the Port of Calcutta, an inspection of their automatic tide-gauge at Phuldobi was made in March 1926, with the object of seeing whether the registrations of the tidal curves which had been recorded at this site for the past nine years, and which are still being continued, could be utilised for the preparation of the tide tables for Phuldobi. An estimate as to the probable cost and time for the reduction of these observations by the harmonic analysis method, and the computations of data for the preparation of tide tables for 1930 was prepared and submitted to the Commissioners of the Port of Calcutta, who, owing to retrenchment, have unfortunately not been able to sanction the expenditure.

20. *Levelling.*—Work for the new geodetic level net of India was continued according to the programme laid down. The following lines of geodetic levelling were run:—

In the 'back' direction only—

(*a*) *Sind.*—Karāchi-Kotri.

(*b*) *Sind and Rājputāna.*—Kotri-Barmer.

(*c*) *Bengal, Bihār & Orissa.*—Midnapore-Rāniganj.

(*d*) *Bengal, Bihār and Orissa.*—Rāniganj-Dinājpur.

In the 'fore' direction only—

(*e*) *United Provinces.*—Muttra-Cawnpore.

(*f*) *United Provinces.*—Cawnpore-Benares.

Total 1,167 miles.

Details of secondary and tertiary levelling for various purposes are given in Part X of this report, (p. 50).

21. No comparator or base-line work was undertaken during the year.

22. *Computing Office.*—Dr. J. deGraaff Hunter, M.A., Sc.D., F. Inst. P., has re-written the article on 'Geodesy' for a new issue of the Encyclopædia Britannica, XIth edition, additional volumes. The original article was written jointly by Col. Sir G. P. Lenox-Conyngham, Kt., R.E., F.R.S., and Dr. Hunter.

A magnetic storm of exceptionally great intensity—the greatest since 1913—was recorded at Dehra Dūn Magnetic Observatory. The disturbance commenced at 21 hrs. 24 mts. on 26th January 1926, reaching an amplitude of ·00374 C. G. S. units.

Numerous computations, both departmental and non-departmental, were carried out, about 120 requisitions being complied with. Twenty-eight degree sheet triangulation pamphlets (including 5 Mesopotamian sheets) were compiled and six were printed. Forty have been reprinted.

Magnetic and meteorological observations were taken throughout the year. The Omori seismograph recorded 27 earthquakes during the year ending 30th September 1926, of which 2 were major and 25 minor. In addition to the regular time observations, preparations for a more precise time service have been in hand, for which a Riefler clock and two other old clocks have been installed in the Hennessey Observatory. Wireless apparatus has been set up for reception of time signal from Annapolis, Bordeaux and Honolulu in connection with the International Longitude scheme which will be carried out in October and November 1926. Arrangements have been perfected in the Hunter Observatory for precise time observations in the same connection.

23. A brief summary of the work of the Publication and Stores Office, No. 2 Drawing Office and Forest Map Office, is given in Abstract V of this report.

V.—ABSTRACT OF MAP PUBLICATION AND OFFICE WORK.

24. Full reports of the work of the printing offices at Calcutta, Dehra Dūn, &c., and of the drawing offices at all branch and circle headquarters, with *indexes* showing the progress and present state of map publication on various scales, have been published separately in the *Map Publication and Office Work Report*, from which the following tables are abstracted to show the net result of all this work in the form of Publications and Issues, for the financial year ending 31st March 1926.

25. The Mathematical Instrument Office has always reported in accordance with the financial year, and not the survey year; so its report, which is abstracted from the Map Publication and Office Work Report, is also for the financial year ending 31st March 1926. This report describes various interesting developments in connection with instruments for medical research and the Army, as well as for surveying, &c. The following table shows a slight decrease in gross demands on this office for the supply of instruments, while the value of the outturn from the workshops shows very little change.

3. During the year from 1st April 1925 to 31st March 1926, the demands on this office for supply and repair of instruments show an increase, compared with the previous year (*vide* items 1 and 2 in the statement below).

		1923-24.	1924-25.	1925-26.
		Rs.	*Rs.*	**Rs.**
1.	Total value of stores issued, as shown in the Profit and Loss statements.	4,46,559	3,75,024	**4,20,340**
2.	Value of repairs to instruments received for repairs, and returned in serviceable condition.	1,56,682	1,28,931	**1,34,008**
3.	Value of instruments received, as no longer required.	54,824	51,875	**51,045**
4.	Book value of the stock of instruments, &c., in Serviceable Store.	5,14,985	3,25,685	**2,55,474**
5.	Book value of the stock of instruments, &c., in Repairable Store.	1,11,113	1,04,559	**81,527**
6.	Total value of work done in the workshop.	3,92,072	3,82,467	**4,31,269**
7.	Value of instruments manufactured in the workshop for Serviceable Store.	1,14,677	1,42,616	**1,75,874**
8.	Value of instruments purchased locally.	13,034	35,356	**43,326**
9.	Value of instruments and materials obtained from England through the Director General, India Store Department.	1,47,723	95,750	**92,003**
10.	Average number of employees and their pay including pension contribution.	No. 402 Rs.1,57,280	No. 386 Rs. 1,52,166	**No. 412** **Rs. 1,60,659**

26. Publications.—The publications of the Department for the year are shown in the following 3 tables, of which Table I shows map publications, Table II letterpress publications, and Table III an abstract of the publication of modern topographical maps to date.

Table I *(a)*—Maps published at Calcutta, during the year 1925-26.

Class of maps.	Scale.	Number of different maps of each class received.		Number of sheets printed.	Value.
		New publications.	New editions and reprints.		
GENERAL MAPS.		*Departmental.*			Rs.
Maps of India	Various	...	6	8,750	9,021
GEOGRAPHICAL MAPS.					
Map of India	1″=32miles	...	...	...	...
Southern Asia series ...	1:2,000,000	...	1	250	750
India and Adjacent Countries series.	1:1,000,000	5	25	11,835	19,004
La Carte Internationale du Monde.	1:1,000,000	...	1	350	350
TOPOGRAPHICAL MAPS.					
Quarter inch, (Modern) ...	1″=4 miles	24	47	28,640	43,756
Do. (Prely.) ...	1″=4 miles	3	6	2,500	4,040
Do. (Provl.) ...	1″=4 miles	...	51	12,340	18,280
Half inch, (Modern) ...	1″=2 miles	69	28	37,265	1,12,973
Do. (Prely.) ...	1″=2 miles	...	...	...	...
Do. (Provl.) ...	1″=2 miles	2	...	400	500
One inch, (Modern) ...	1″=1 mile	127	169	195,795	325,386
Do. (Prely.) ...	1″=1 mile	7	5	4,210	6,361
Do. (Provl.) ...	1″=1 mile	...	...	...	...
Old style sheets	Various	...	26	3,375	5,643
SPECIAL MAPS.					
District maps	1″=4 miles	...	...	...	...
Administration report maps ...	1″=8 miles	...	3	275	102
Provincial maps	Various	3	4	5,475	17,269
Plans of Cities and Cantonments	Various	1	1	1,050	3,000
Index maps	Various	1	1	650	318
Miscellaneous maps ...	Various	50	36	47,064	17,915
Total ...	.....	**292**	**410**	**360,224**	**5,84,668**
		Extra-departmental.			
Maps	Various	145	52	175,676	38,370
Plans and diagrams ...	Various	317	12	141,026	18,249
Illustrations	.....	162	1	57,719	13,149
Miscellaneous	.....	102	32	299,793	16,410
Total ...	.....	**726**	**97**	**674,214**	**81,178**
Grand Total ...	.....	**1,018**	**507**	**1,034,438**	**6,65,846**

Table I *(b)*—Maps published at Dehra Dūn.

Class of maps.	Scale.	New publications.	Reprints and new editions.	Number of sheets printed.	Value. Rs.	as.	p.
		Departmental.					
Cantonment maps ...	Various	44	62	14,674	29,348	0	0
Forest maps ...	,,	57	46	10,623	12,656	4	0
Miscellaneous ...	,,	9	2	4,767	3,231	13	3
Total ...	...	**110**	**110**	**30,064**	**45,236**	**1**	**3**
		Extra-departmental.					
Maps	Various	565	21	170,147	25,748	9	8
Plans & diagrams ...	,,	43	...	80,119	1,368	1	0
Charts	4″ = 1 mile	324	...	116,125	9,110	1	0
Total ...	...	**932**	**21**	**316,391**	**36,226**	**11**	**8**
Grand Total ...	...	**1,042**	**131**	**346,455**	**81,462**	**12**	**11**

Notes.

27. *Calcutta.*—Map publication was considerably delayed by the heavy work of surprinting minute meshes for the Army Department on a very large number of maps already published. As these maps were trimmed and also in many cases folded, the surprinting could only be effected in hand-presses, and registration was difficult and often imperfect. This work left insufficient hand-presses for ordinary proof work.

28. *Dehra Dūn.*—In addition to the work shown in Table I(*b*) above, 66,063 prints of 972 originals, consisting of plane-table sections, triangulation charts and pamphlets, and forest maps were printed free of charge.

In June 1925, the outturn of negatives reached a record of 287 negatives, and in October 1925, the outturn of the printing machines reached a record of 55,764 prints, representing 86,186 pulls.

Table II.—Letterpress publications.

(a) Published at Calcutta.

1. Survey of India General Report, 1924-25. Price Re. 1 or 1s. 9d. (475 copies).
2. Survey of India Map Publication and Office Work Report, 1924-25. Price Re. 1 or 1s. 9d. (475 copies).
3. Confidential Supplement to the Survey of India General Report, 1923-24.
4. Confidential Supplement to the Survey of India General Report, 1924-25.
5. Government of India Orders Nos. 814 to 819.
6. Survey Notes—from February 1925 to February 1926 (350 copies for each month).
7. Circular Order No. 293, reprint (300 copies).
8. Booklet for Conventional Signs for use on P. T. Sections (1,000 copies).
9. Catalogue of Maps, Confidential (150 copies).
10. Sections 1 to 4 of the Hand-book of Topography, Chapter VIII (600 copies).
11. Correction No. 28, to the Hand-book of Topography, Chapter I, 1921 (600 copies).
12. Correction No. 2, to the Hand-book of Topography, Chapter II, 1923 (600 copies).
13. Corrections Nos. 1 and 2, to the Hand-book of Topography, Chapter IV, 1924 (600 copies each).
14. Corrections Nos. 134 to 138, 141, 142, 144, 145 and 146, to the Hand-book of Topography, Chapter VI, 1922 (650 copies each).
15. Corrections Nos. 16, 17 and 19 to the Hand-book of Topography, Chapter X, 1919 (600 copies each).
16. Corrections No. 14, to Border Specimen for Topographical Maps, January 1920, (1,000 copies).
17. Corrections Nos. 15 & 16, to Type-Table for Topographical Maps, December 1920, (1,000 copies each).
18. List of published maps for record in the office of the High Commissioner for India, General Department, Record Branch, London and for sale to the public for the quarters ending 31st December 1924, 31st March, 30th June, 30th September and 31st December 1925 (50 copies for each quarter).
19. List of published maps, "For Official Use Only", for record in the office of the High Commissioner for India, General Department, Record Branch, London and not for sale to the public for the quarters ending 31st December 1924, 31st March, 30th June, 30th September and 31st December 1925 (10 copies for each quarter).
20. Map publication lists—From February 1925, to February 1926 (800 copies each month).
21. Instructions for applicants for appointment as Class II officers (300 copies).
22. Rules to be observed in the examination of candidates for the Class II service of the Survey of India (200 copies).
23. Rules for the guidance of officers conducting the Class II service examination (100 copies).
24. Appendices, tables on title-pages etc., for the Memorandum by the Surveyor General on the pay of Class II officers (200 copies).
25. Rules for the appointment of store keepers in field parties (200 copies).
26. Addenda and corrigenda to regulations on the subject of Language Examinations etc. 10th and 11th lists of corrections (400 copies each).
27. Calendar for 1926 (3,000 copies).

Table II *(a)*—*(Concld.)*.

28. Rules and regulations of the M. I. O. (5,000 copies).
29. Account rules of the M. I. O. (30 copies).
30. Annual indent for D. O. (15 copies).
31. Annual indent for E. O. (15 copies).
32. Photo.-Litho. Office annual indent (15 copies).
33. M. I. O. annual indent and supplementary indent (15 copies each).

(b) In Hand at Calcutta.

1. *Government of India Orders—Re changes in nomenclature of Class I officers.*
2. *Government of India Orders—Re date from which sanctions accorded by the Secretary of State in Council should take effect.*
3. *Hand-book of Topography, Chapter V.*
4. " " " *VIII (from Section V).*
5. " " " *XI.*
6. *Correction Nos. 163 to 178, to the Hand-book of Topography, Chapter VI (1922).*
7. *Correction No. 17, to Type Table for Topographical Maps (1920).*
8. *List of names for the Simla Guide Map.*
9. *List of names for the Bangalore Guide Map.*
10. *P. L. O. annual indent.*

(c) PUBLISHED AT DEHRA DŪN.

1. Records of the Survey of India, Vol. XX. The War Record 1914—20 (720 copies).
2. Hand-book of Topography Chapter IX (660 copies).
3. 18 Triangulation Pamphlets and Addenda to 1/M sheet 61 (1,400 copies).
4. Additional tables (Traverse) to Auxilliary Tables Part III (500 copies).
5. Tide Tables for Indian ports for 1926 (5,190 copies).
6. New data for Levelling Pamphlets, 53, 57, 79 (650 copies).
7. Additions and corrections No. 2, to Routes in the Western Himālaya, Kashmīr &c. Vol. I of January 1926 (500 copies).
8. 69 correction slips to Forest Map Catalogue (10,350 copies).
9. Forest Map Office Record book (50 copies).
10. Professional forms (129,878 copies).
11. Miscellaneous (131,009 copies).

(d) In Hand at Dehra Dūn.

1. *Records of the Survey of India, Vol. XIX. The Magnetic Survey of India.*
2. *Records of the Survey of India, Vol. XXI. (1) Air Survey in the Irrawaddy delta by Major C. G. Lewis, R.E., and (2) Narrative Report of Bhutān and South Tibet Survey Detachment by Captain H. R. C. Meade, I.A.*
3. *Government of India and Circular Orders (Administrative) from January 1919 to 31st December 1924.*
4. *Professional Paper No. 20—Reconnaissance Survey from Aircraft by Lt. Colonel G. A. Beazeley, D.S.O., R.E.*
5. *Auxiliary Tables Part I. Fifth edition (reprint).*
6. *The Tides—Part V of the Hand-book of Trigonometrical Instructions.*
7. *Levelling of Precision—Part VI of the Hand-book of Trigonometrical Instructions.*
8. *Levelling Pamphlet 44 (revised and extended). Addenda to Pamphlets 41 & 46.*
9. *Waziristān Air Survey.*
10. *List of Cantonments and Military Stations.*

Table III.—Publication of modern topographical maps.

Years of publication.	Number of sheets published.		
	One inch sheets.	Half inch sheets.	Quarter inch or Degree sheets.
1925-26	127	69	27
Previous years	2,157	540	125
Total published ...	**2,284**	**609**	**152**
Number of sheets in India ...	**6,218**	**1,630**	**450**

Map issues.—The following tables show the number of maps issued during the year.

Table IV *(a)*.—Map issues, Calcutta.

	On book transfer (to Government officials).		On cash payment.		Free issues.		**TOTAL.**	
	Number of copies.	Value. Rs.	Number of copies.	Value. Rs.	Number of copies.	Value. Rs.	**Number of copies.**	**Value. Rs.**
Departmental.	61,347	87,673	63,869	91,556	29,551	48,639	154,767	2,27,868
Extra-departmental.	898,378	84,727	68,982	26,659	2,761	3,147	970,121	1,14,533
Total ...	959,725	1,72,400	132,851	118,215	32,312	51,786	1,124,888	3,42,401

Table IV *(b)*.—Map issues, Dehra Dūn & Circles.

Branch or Circle.	On book transfer (to Government officials).		On cash payment.		Free issues.		**TOTAL.**	
	Number of copies.	Value. Rs.	Number of copies.	Value. Rs.	Number of copies.	Value. Rs.	**Number of copies.**	**Value. Rs.**
Dehra Dūn (F. M. O.).	14,290	13,798	2,183	3,425	4,545	8,519	21,018	25,742
Dūn (No. 2 D. O.	1,540	2,281	1,018	2,040	3,706	10,473	6,264	14,794
Central Circle ...	.....	.....	164	317	.....	.....	164	317
Southern Circle ...	426	813	1,939	3,244	.....	.....	2,365	4,057
Eastern Circle ...	.....	.....	133	271	.....	.....	133	271
Burma Circle ...	.....	.....	57	154	.....	.....	57	154
Total ...	16,256	16,892	5,494	9,451	8,251	18,992	30,001	45,335

29. Map Record and Issue Office, Calcutta.—During the year under review, the issues of departmental publications on book debit to government officials were less than those for recent years; other issues were generally the same. The decrease is mainly due to the fact that from 1921 to 1925 large new issues were made to the Army for mobilization purposes, as their old stocks were out of date; this demand has now practically ceased.

Sales to the general public have remained much the same, but the number of demands and enquiries has increased by over one thousand and is now 11,500. The publication of modern surveys in the neighbourhood of Bombay should lead to increases; especially if a suitable selling agency is established there.

The total number of shelves constructed to date in the map store-rooms is 6,750, as against about 10,000 required for the full survey programme, as at present foreseen.

In the "original" record room an additional 40 shelves were completed, bringing the total to 600. These will accomodate nearly all the fair originals of the present survey programme.

VI.—SURVEY REPORTS, CENTRAL CIRCLE.

DIRECTOR
- Lt.-Col. L. C. Thuillier, I.A., to 2nd November 1925.
- Major V. R. Cotter, I.A., from 3rd November 1925 to 27th November 1925.
- Lt.-Col. R. H. Thomas, D.S.O., R.E., from 28th November 1925 to 9th March 1926.
- Lt.-Col. R. H. Phillimore, D.S.O., R.E., from 10th March 1926.

30. Summary.—The designation of Northern Circle was changed to Central Circle from April 1st 1926. Nos. 1 and 22 Parties, the Jhānsi Survey Detachment and No. 3 Drawing Office were administered by this circle throughout the year. No. 23 Party was transferred to the Frontier Circle from 1st July 1926, and No. 5 Party was transferred from Southern Circle on April 1st, 1926. A small Railway Survey Detachment was formed for the field season only, under Rai Sahib Nanak Chand Puri.

The officer in charge of No. 5 Party in addition to his normal duties, acted as Assistant Director of Surveys, Central Provinces, and administered the revenue, town, and other surveys of that province.

31. One Upper Subordinate officer from No. 3 Drawing office was deputed to lay down a forest boundary between Bahraich Forest Division and Kheri district. The work occupied six weeks, and the cost was debited to the Forest Department.

32. *Training.*—11 pupil surveyors and 2 soldier surveyors made satisfactory progress in one inch topographical survey.

47 pupil surveyors were employed on 4 inch survey in No. 23 Party and on conclusion of the work of the Sutlej Valley Project in June 1926, 46 were distributed among other units.

33. Railway Survey Detachment.—*Special surveys.*—At the request of the Chief Engineer, East Indian Railway, an area of 56 square miles was surveyed on the scale 4 inches = 1 mile, with contours at 2 feet vertical interval, at the points where the Solāni and Rāmgangā rivers caused serious breaches of the railway near Laksar and Morādābād during the floods of September 1924.

PERSONNEL.
Class II Officer.
Rai Sahib Nanak Chand Puri, in charge.
Lower Subordinate Service.
15 Surveyors, etc.

The Solāni river area lay in Sahāranpur district; the Rāmgangā area lay in Morādābād district.

Work lasted from November to April; no fair mapping was required.

The whole cost was borne by the East Indian Railway.

34. No. 1 Party.—*Topographical surveys.*—This party surveyed an area of 2,660 square miles on the scale 1 inch = 1 mile in Bāndā, Cawnpore, Fatehpur, and Hamirpur districts of the United Provinces, 560 square miles in Ajaigarh, Baonī, Berī, Charkhārī, Chhatarpur, and Gaurihār States of the Bundelkhand Agency and a small area of the Baghelkhand Agency of Central India; a total of 3,222 square miles.

PERSONNEL.

Class I Officer.

Major R. Foster, I.A., in charge from 26th October 1925.

Class II Officers.

Mr. P. A. T. Kenny, O.B.E., in charge from 16th July 1925 to 25th October 1925.
Mr. A. M. Talati, L.C.E.
Major C. H. Treiham.
Mr. Seth Ram Gupta, (on probation).

Upper Subordinate Service.

2 Officers.

Lower Subordinate Service.

43 Surveyors, etc.

35. *Nature of country.*—The country surveyed on the scale 1 inch = 1 mile consisted of cultivated plains in Cawnpore, Fatehpur, Hamirpur and the north of Bāndā district, flat and covered with numerous swamps and groves of trees in the two former districts, much more open and slightly undulating in the rest of the area. In the south of Bāndā district and the Indian states the country rises and is covered with numerous isolated rocky outcrops finally touching, in the south, the forest clad plateau of the Bindhāchal range of the Vindhyas.

36. *Triangulation.*—An area of 6,834 square miles was triangulated in advance in Palāmau and part of Rānchī and Hazāribāgh districts of the Bihār and Orissa Province and Sargujā State of the Central Provinces.

37. *Training.*—Two soldier surveyors, 3 draftsmen and 8 pupil surveyors joined the party and underwent a course of instruction in surveying in the field. After 2 months training they were entrusted with the survey of a portion of the area.

38. *Boundary demarcation.*—One surveyor, during December 1925, was deputed to demarcate the boundary between the villages of Amchauli and Galauli in the Bāndā tahsīl of Bāndā district, at the request of the Munsif of Bāndā, for the purpose of settling a dispute in a case pending in his court, the cost of the work being paid by the litigants.

A small estate in Naini Tāl was surveyed by one surveyor on the scale 1 inch = 40 feet, the cost of survey being met by the owner.

39. No. 5 Party.—*Topographical surveys.*—This party surveyed a total area of 2,846 square miles on the scale 1 inch = 1 mile in the Bālāghāt, Bhandāra, Mandlā and Seoni districts of the Central Provinces. In addition, an area of 4,457 square miles was triangulated in the Bhandāra, Chānda, Nāgpur and Wardhā districts.

PERSONNEL.
Class I Officer.
Major H. E. Roome, M.C., R.E., in charge.
Class II Officers.
Mr. N. N. Chuckorbutty, L.C.E.
,, A. F. Murphy.
Upper Subordinate Service.
3 Officers.
Lower Subordinate Service.
20 Surveyors, etc.

40. *Forest surveys.*—In the Bālāghāt, Bhandāra, Mandlā and Seoni Forest Divisions of the Northern and Southern Forest Circles, Central Provinces, an area of 671 square miles of reserved forests, for which four inch sheets already existed, was revised on the scale 1 inch = 1 mile, during the work outlined above. In addition, in the Mandlā Forest Division an area of 1·2 square miles of reserved forest was surveyed on the scale 4 inches = 1 mile.

41. *Nature of country.*—The country surveyed in the northern and southern portions consists mainly of densely wooded plains and hills interspersed with cultivation, while the central sector comprised well cultivated plains generally covered with trees and containing numerous small tanks. The principal river is the Waingangā. The western half of the area is intersected with irrigation channels, fed from the Waingangā River and certain large lakes.

42. *Boundary survey for the Central Provinces Government.*—One surveyor was deputed to accompany the Central Provinces Boundary Officer and to map 83 linear miles of boundary between Raipur district, Central Provinces and Patnā State.

43. *Pachmarhī Guide Map.*—At the request of the Central Provinces Government, an area of 6 square miles was surveyed on the scale 4 inches = 1 mile.

44. *Field of firing map.*—At the request of the Small Arms School, Pachmarhi, two maps of their field of firing areas were prepared on the scale 16 inches = 1 mile.

45. Jhānsi Survey Detachment.—*Topographical surveys.*—This Detachment was formed on 1st October 1925 to carry on topographical surveys in the United Provinces and Central India, in the neighbourhood of Jhānsi, and surveyed an area of 2,752 square

PERSONNEL.
Class II Officers.
Mr. P. A. T. Kenny, O.B.E., in charge from 28th October 1925.
Mr. J. C. C. Lears, in charge from 1st to 27th October 1925.
Mr. O. D. Jackson.
,, M. N. A. Hashmi, B.A., (on probation).
Lower Subordinate Service.
20 Surveyors, etc.

miles on the scale 1 inch = 1 mile. This includes 1,074 square miles in the Jhānsi district of the United Provinces, 810 square miles in the Gwalior State, 854 square miles in the Orchhā State of the Bundelkhand Agency of Central India, and 14 square miles in the Khaniādhāna State of the Gwalior Residency of Central India.

550 square miles of the above area was triangulated during the field season for supplementary heights.

46. *Forest surveys.*—In the Jhānsi Forest Division, Eastern Forest Circle, U. P., an area of 25 square miles of reserved forests, for which four inch sheets already existed, was revised on the scale 1 inch = 1 mile during the work outlined above.

47. *Nature of country.*—The country surveyed consisted of dense jungle-clad hills and undulating plains, partly cultivated and partly covered with thorny scrub.

48. *Training.*—Three pupils and one draftsman joined for training and received instruction in planetabling during the field season 1925-26 and in drawing during the recess of 1926.

49. No. 22 (Riverain) Party.—*Traverses.*—This party continued the work of traversing and laying down base-lines. 297 linear and 285 square miles of main-circuits along the Rāvi river in Lyallpur, Shekhūpura and Montgomery districts and 3,698 linear miles and 768 square miles of minor traverses in the Indus riverain tract in Miānwāli district and in the Jhelum riverain tract in Jhelum district were executed. 509 theodolite stations of the former and 17,783 of the latter in 238 villages were fixed. 339 corners of 114 base-lines in 904 square miles were demarcated with permanent mark-stones on both banks of the Indus river in Miānwāli district and Jhelum river in Jhelum district and Kashmīr State to serve as bases for future survey and demarcation of boundaries and fields in the bed of the rivers. 2,618 plotted and 639 boundary *musāvis* (settlement mapping sheets) on the scale of 1/2640 and 37 four inch sheets were traced and supplied to the Settlement Officer, Miānwāli and the Deputy Commissioner Jhelum district. Besides these, 477 miscellaneous traces were prepared, and all the traverse stations marked during the field season were plotted on 43 four inch sheets.

PERSONNEL.
Class I Officer.
Mr. Dhani Ram Verma, R.S., in charge.
Upper Subordinate Service.
4 Officers.
Lower Subordinate Service.
37 Surveyors, traversers, etc., (excluding 46 purely temporary men and 11 pupils).

50. *Punjab-U. P. boundary demarcation.*—This was undertaken for the Punjab and U. P. Governments. It comprised original survey on the scale 4 inches = 1 mile of the villages of Gurgaon district in the

Punjab and Bulandshahr district in the United Provinces along the Jumna river, proposed for transfer from one province to the other, and demarcation of the new inter-provincial boundary with stone pillars.

For this purpose boundaries of villages were traversed and main-circuits were run along both banks of the river; in all 447 linear miles were traversed and 2,021 stations were fixed. 46 square miles were surveyed on scale of 4 inches = 1 mile. 288 stone pillars were erected on the new inter-provincial boundary. 8 four inch plot-sheets of traverses were prepared for future use.

51. *Ambāla-Sirmūr boundary survey.*—This was undertaken for the Deputy Commissioner, Ambāla district. The work consisted in traversing the boundaries of villages Jhanda, Sālepur and Thaska of Ambāla district, the northern portions coinciding with the boundary of Sirmūr State in dispute and plotting the boundaries on *musāvis* on the same scale as that of the settlement *musāvis* of the district. 19 linear miles were traversed and 137 stations were fixed. 30 boundary plots were prepared and supplied to the Deputy Commissioner, Ambāla.

52. *Muttra Nuzūl land survey.*—This was undertaken for the Municipal Board, Muttra (U. P.). It comprised revision of the existing property map of the Sadar Bāzār on the scale 64 inches = 1 mile. For this purpose main and minor traverses were carried out. In all 11 linear miles were traversed and 446 stations were fixed. Each individual property was measured and its superficial contents were worked out, the total area surveyed was 70 acres. A special map with a schedule of the properties surveyed and their areas in acres was prepared to enable the municipal board to prepare the *khasra* and to work out encroachments on municipal land.

53. No. 23 Party.—*Sutlej Valley Irrigation Project.*—During the year the party was employed on 4 inch topographical survey of the area commanded by the Sutlej Valley Irrigation Project in the Montgomery, Lahore and Ferozepore districts, in continuation of the area surveyed by No. 20 Party in 1924-25. A small area round the Panjnad weir sites in district Muzaffargarh, commanded by the same project, was also traversed and surveyed on the scale 4 inches=1 mile. The party also rectangulated a small strip along the

PERSONNEL.

Class I Officer.

Major J. D. Campbell, D.S.O., R.E., in charge, excluding a month from 4th January 1926.

Class II Officers.

Mr. H. B. Simons, from 28th December 1925 in charge from 4th January 1926 to 3rd February; 1926.

Mr. O. N. Pushong.

,, J. H. Johnson.

Captain J. O'C. Fitzpatrick from 6th October 1925 to 22nd February 1926.

Mr. Duni Chand Puri.

Upper Subordinate Service.

2 Officers.

Lower Subordinate Service.

66 Surveyors, etc., and pupils (excluding 73 purely temporary men).

Bikaner canal, being an extension of the area previously rectangulated by the party in the Ferozepore district.

A total area of 2,423·85 square miles was surveyed, 37·84 linear miles traversed, and 145 square miles rectangulated into 25-acre rectangles.

The country surveyed lies on either bank of the Sutlej River and consists partly of populated country, cultivated and watered by inundation canals, and partly of desert with open scrub jungle and some sand hills.

Published sheets were reproduced in black by photography from the original plane-table sections. A small drawing section was formed during the field season to deal with typing, etc. 66 plane-table sections were submitted for publication during the field season and the remainder early in recess.

VII.—SURVEY REPORTS, FRONTIER CIRCLE.

DIRECTOR:—{Lt.-Col. C. P. Gunter, O.B.E., R.E., from 1-10-25 to 14-3-26.
Lt.-Col. R. H. Thomas, D.S.O., R.E., from 15-3-26.

54. Summary.—The following units were administered by the Frontier Circle during the year:—A and E Companies, Nos. 18 and 19 Parties, No. 6 Drawing Office (Simla), and Settlement Survey Detachment. No. 19 Party was temporarily transferred to the control of the Director Geodetic Branch from 12th April 1926. No. 23 Party was transferred from the Central to the Frontier Circle from 1st July 1926. Its report appears under the Central Circle.

55. *Training.*—Two Class II probationers, nine Upper Subordinate probationers, eleven pupil surveyors, eleven soldier surveyors and two purely temporary traversers commenced or continued their training in field and recess work in A and E Companies during the year. Three Upper Subordinate probationers were discharged as unlikely to become efficient officers and two soldier surveyors reverted to their units at the termination of first period of their extra training.

56. *Party reports.*—Particulars of the work done by the field units of the circle are given below.

57. A. Survey Company.—*Topographical surveys.*—This Company surveyed a total area of 3,607 square miles on the scales 1 inch and 1½ inches = 1 mile. This includes 800 square miles on the scale 1 inch = 1 mile and 70 square miles on the scale 1½ inches = 1 mile original survey in Swāt and Buner, 2,270 square miles on the scale 1½ inches = 1 mile revision survey in Peshāwar and Hazāra districts in the North-west Frontier Province: 467 square miles of revision survey or re-survey in the Attock and Rāwalpindi districts in the Punjab.

PERSONNEL.

Class I Officers.

Lt.-Col. R. H. Phillimore, D.S.O., R.E., in charge from 12th November 1925 to 2nd March 1926.

Captain W. J. Norman, M.C., R.E., in charge to 11th November 1925 and from 3rd March 1926.

Captain G. F. Heaney, R.E., (on probation).

Lieut J. B. P. Angwin, R.E.

Class II Officers.

Mr. A. A. Graham.
" F. W. Smith.
" C. M. Aslam, B.A.
" T. M. C. Alexander, (on probation).

Upper Subordinate Service.

2 Officers.

Lower Subordinate Service.

24 Surveyors, etc.

An area of 1,550 square miles has been triangulated in advance for detail surveys on the scales ½ inch and 1½ inches = 1 mile in Hazāra district and tribal territory in the North-west Frontier Province.

58. *Rāwalpindi four inch Guide Map.*—Triangulation in advance of 100 square miles has been carried out for a four inch Guide Map of Rāwalpindi and environs.

59. *Nature of country.*—The country surveyed comprises highly cultivated plains, arid plains, bare foot-hills and medium hills partly wooded.

60. *Training.*—Six soldier surveyors and seven pupil surveyors joined for training during the year and received instruction in plane-tabling on the scale 1½ inches = 1 mile during the cold weather and on the scale 4 inches = 1 mile in the hills during the hot weather. In addition they received instruction in drawing, plotting and projection.

61. *Air survey of Wazīristān.*—The compilation made from air-photos by No. 18 Party has been incorporated in sheets 38 H/13,15, 38L/1,2,3,5,6 and these sheets have been redrawn.

62. *Survey in Buner and Swāt.*—This year's work included the revision of sheets 43 B/2,7,11 as the Upper and Lower Swāt canals have been constructed since the original survey. These sheets have never been completely surveyed, the portion of Buner included in them being omitted. Buner which lies to the north of Peshāwar district and between the Indus and the Swāt rivers together with the Swāt Valley above Chakdarra has hitherto, like the remainder of tribal territory, been closed to the surveyor. During the last few years the Miān Gul has extended and consolidated his position and has now firmly established himself as ruler of all Swāt and Buner. While survey work was being carried out in Peshāwar district, the political authorities were asked if the survey could be extended into Buner. This the Miān Gul consented to allow and he also gave permission for the survey of a considerably larger area comprising most of sheets 43 B/5, 6, 9, 10, 13. It was considered advisable that the work should be done at once. Mr. C. M. Aslam therefore commenced triangulation in February and the detail survey was commenced in the middle of May.

Likewise, taking advantage of the present political situation, Sir Aurel Stein, K.C.I.E., obtained permission to enter the Miān Gul's dominions to carry on archæological research. As he was entering unknown country, a surveyor, Torabāz Khān, was sent with him. He was able to survey Upper Swāt on the scale ½ inch = 1 mile.

63. *Co-operation with the Royal Artillery.*—In November 1925 Lieut. G. F. Heaney, R.E., attended the R. A. Practice Camp at Akora and studied the survey methods used by battery officers.

Captain W. J. Norman, M.C., R.E., attended manœuvres with the R. A. Survey Section in November 1925.

In January 1926 Colonel C. P. Gunter, O.B.E., R.E., Director, Frontier Circle and Lt.-Colonel R. H. Phillimore, D.S.O., R.E., attended a conference with the Major General Commanding the Royal Artillery at Akora.

In February 1926 Lt.-Colonel R. H. Phillimore, D.S.O., R.E., visited Kākul and inspected the R. A. Survey Section at work.

64. E. Survey Company.—*Topographical surveys.*—This company surveyed an area of 281 square miles in Las Bela State in Baluchistān, 784 square miles in the Karāchi district and 307 square miles in the Hyderābād district of the Sind province on the scale 1½ inches = 1 mile; and 61 square miles in Las Bela State and 666 square miles in the Karāchi district on the scale 2 inches = 1 mile.

PERSONNEL.

Class I Officers.

Bt.-Lieut.-Col. S. W. S. Hamilton, D.S.O., R.E., in charge to 8th April 1926.

Major E. O. Wheeler, M.C., R.E., in charge from 9th April 1926.

Lieut. G. Bomford, R.E. (on probation).

,, D. R. Crone, R.E. (on probation).

Class II Officers.

Mr. A. J. A. Drake, D.C.M.

,, Abdul Karim, B.A.

,, J. C. Berry, (on probatoin).

,, M. R. Nair, B.A. (on probation).

Upper Subordinate Service.

11 Officers (9 on probation).

Lower Subordinate Service.

22 Surveyors, etc.

1,050 square miles of triangulation and 328 square miles of traversing, covering a total area of 1,378 square miles, were carried out in Las Bela State and Hyderābād and Karāchi districts, and computed in advance of the detail survey. An area of 370 square miles was triangulated, 900 square miles reconnoitred for triangulation and 270 square miles traversed in advance for next season's detail survey, in Karāchi district.

65. *Forest surveys.*—In the Hyderābād and Karāchi Forest Divisions of the Sind Forest Circle, an area of some 81 square miles of reserved forests, for which 1 inch, and in some cases, 2 inch old style topographical maps existed, was resurveyed on the scale 1½ inches = 1 mile during the course of the topographical surveys.

66. *Nature of country.*—The country surveyed included the cities of Karāchi and Hyderābād (Sind) and the southern extremities of the Pab and Kirthar ranges of hills on either side of the Hab river.

Otherwise the country consisted of plains with occasional low undulating hills, open, waterless and devoid of trees or cultivation around Karāchi and on the right bank of the river Indus, while that on the left bank, being a canal area, was mostly covered with trees and thick vegetation.

67. *Training.*—Two Class II officers, nine Upper Subordinate officers, four pupil surveyors, five soldier surveyors and two purely temporary traversers commenced or continued their training in field and recess work during the year.

68. No. 18 (Air Survey) Party.—*Cadastral surveys.* The experimental work in connection with the construction of cadastral maps based on air-photographs, referred to in last year's report, has been continued and the following large scale Settlement Surveys have been carried out.

PERSONNEL.
Class I Officers.
Captain O. Slater, M.C., R.E., in charge, up to 16-11-25.
Captain W. J. Norman, M.C., R.E., in charge up to 28-2-26.
Captain G. F. Heaney, R.E., in charge from 1-3-26.
Class II Officers.
Nil
Upper Subordinate Service.
1 Officer.
Lower Subordinate Service.
7 Surveyors, etc.

An area of 14 square miles in the Swābi *tahsīl* of Peshāwar district was photographed by the Royal Air Force and *musāvis* on the scale 24 inches = 1 mile, showing boundaries of field and other detail required in Settlement Surveys, were prepared for the Settlement Officer, Peshāwar district. The country was nearly all cultivated and fairly level and therefore suitable for air survey.

An area of 140 square miles in the Pindi Gheb *tahsīl* of Attock district was photographed and *musāvis* on the scale 16 inches = 1 mile were prepared for the Settlement Officer Campbellpore. The area was not very heavily cultivated. From the experience gained in these two surveys improved methods and organization have been evolved, which should be of considerable value if more of this work is to be undertaken in the future.

69. *Surveys of the river Indus.*—An area of 200 square miles astride the river Indus above and below the town of Dera Ismāil Khān was photographed and mapped on the scale 4 inches = 1 mile for the Irrigation Department N. W. F. P.

A mosaic, on the scale 3 inches = 1 mile, of 20 miles of the river Indus south of Hyderābād (Sind) was constructed for the Chief Engineer in Sind.

70. *Surveys on the Frontier.*—The air survey of inaccessible parts of the North Western Frontier, also referred to in last year's report, was continued and gaps, covering an area of about 45 square miles in the existing compilations of Waziristān on the scale 1½ inches = 1 mile, were filled in, in co-operation with the Royal Air Force.

71. Settlement Survey Detachment.—The detachment continued the work of triangulation, traversing, and frontier boundary survey in the Peshāwar district (*tahsīls* Mardān, Swābi, and Nowshera), and that of supplementing points and post-pointing in the Pindi Gheb *tahsīl* of the Attock district.

PERSONNEL.
Class II Officers.
Mr. Maya Das Puri, B.S., in charge.
,, Mahammad Najamuddin, B.A.
Upper Subordinate Service.
4 Officers.
Lower Subordinate Service.
31 Surveyors, etc. (excluding 62 purely temporary men).

72. *Indus survey.*—At the special request of the Settlement Officer, Peshāwar, the survey of the Indus river towards Peshāwar, on the scale 24 inches = 1 mile was undertaken showing *belās* (wooded and grassy islands), main channels and supplementary points fixed by plane-table intersection for the use of *patwāris* for demarcating boundaries in the bed of the river. 44·8 square miles of the river facing the Attock and the Hazāra districts up to village Jahāngira of the Swābi *tahsīl* were surveyed. For the portion falling opposite the Hazāra district, 10 linear miles of road running along the river and several *pakka* points were also surveyed on the same scale to serve as references for the future demarcation of the district boundary in the bed of the river. 116 surveyed *mausāvis* (settlement mapping sheets) and a congregated compiled map on the scale 4 inches = 1 mile were supplied to the Settlement authorities.

73. *Frontier boundary survey.*—In continuation of the work done last year, 45 linear miles of the frontier boundary (*tahsīls* Mardān and Swābi, and a few alterations made by the Settlement Officer in the Chārsadda frontier boundary, 52 linear miles of internal village boundaries in the Swābi *tahsīl*, and about 300 acres of scattered cultivation in Mardān were surveyed on the scale 24 inches = 1 mile.

74. *Nowshera Hills boundary survey.*—As arranged by the Settlement Officer, Peshāwar, the survey of village boundaries in the Nowshera hills was taken up at the end of January, when a portion of the Nowshera triangulation had been completed on the scale 12 inches = 1 mile. 335 linear miles of boundaries of 56 villages in 305 square miles, were surveyed; and 121 surveyed and 625 plotted *mausāvis* were supplied to the Extra Assistant Settlement Officer, Nowshera. Much trouble was experienced in this part, as it was mostly barren and dangerous; moreover the local officials found great difficulty in pointing out boundaries on the ground owing to defective maps of the last settlement.

Five Lower Subordinate officers were given preliminary instruction in plane-tabling on the scale 12 inches = 1 mile for over a month during March and April with a view to utilizing their services next field season for surveying boundaries and cultivation in the Nowshera hills.

75. *Out-turn.*—In addition to the above, the following work was completed for the Settlement Officers:—

Peshāwar:—2,191·7 linear miles were traversed in 702 square miles of 164 villages in the Nowshera *tahsīl* and 8,163 theodolite stations laid out on the ground. 445 square miles of the Nowshera hills and 1 square

mile of the Mardān frontier disputed boundary were triangulated, and 393 stations and 982 intersected points laid out.

703 square miles were computed and plotted, also 2,029 plotted *musāvis*, 102 riverain compiled boundary *musāvis* on the scale 24 inches = 1 mile and 239 four inch indexes and their traces were supplied to the Settlement Officer.

Besides these, 1,008 miscellaneous traces were prepared, and all the work done during the year plotted on four inch sheets.

87 four inch indexes of 104 villages were reduced by pentagraph to the scale 1 inch = 1 mile, and boundaries compiled on 8 one inch topographical sheets of the Nowshera *tahsīl*.

The area of 377 villages (209 in Chārsadda, and 168 in Mardān) containing 884 square miles was extracted by planimeter and graphically from the twentyfour inch settlement survey *musāvis*.

407 *musāvis* of 43 villages (14 in Chārsadda, and 29 in Mardān) were traced on paper for experimental use by the *patwāris*.

450 twentyfour inch *musāvis* of 32 villages in Mardān, were reduced by pentagraph to the scale 4 inches = 1 mile, 32 four inch indexes prepared and the rectangles of 4,000 *musāvis* corrected.

5 congregated maps *viz.*, two of Chārsadda and two of Mardān *tahsīl*, showing assessment circles and detail (scale $\frac{1}{4}$ inch = 1 mile), and one of Mardān *tahsīl*, showing frontier boundary and detail (scale 4 inches = 1 mile) were compiled for the Settlement Officer.

102 reductions on the scale $1\frac{1}{2}$ inches = 1 mile, showing boundaries and detail, were prepared for A Company.

Attock.—2,039 points were supplemented by plane-table intersection in 95·9 square miles of 7 villages on 120 *musāvis* on the scale 16 inches 1 mile for surveying detail; also 1,763 points were post marked on 110 sixteen-inch *musāvis*; and photographs in 140 square miles for compiling the revenue maps from the aero-photo survey and 71 sixteen inch *musāvis* compiled and supplied to the Settlement Officer.

76. *Nature of country.*—The ground in the Mardān and the Swābi frontier was generally hilly. The Indus riverain area was sandy, shrubby, and contained many very valuable wooded islands. The major portion of the Nowshera *tahsīl* was barren, hilly and contained scattered patches of cultivation, while parts along the Kābul river were very fertile and well irrigated. The Pindi Gheb area was undulating, broken, hilly and poorly cultivated.

VIII.—SURVEY REPORTS, SOUTHERN CIRCLE.

DIRECTOR:—
Lt.-Col. M. O'C. Tandy, D.S.O., O.B.E., R.E., from 12th May 1925 to 15th November 1925.
Lt.-Col. L. C. Thuillier, I.A., from 16th November 1925 to 18th April 1926.
Lt.-Col. C. M. Browne, C.M.G., D.S.O., R.E., from 19th April 1926.

77. Summary.—The parties, etc., administered by the Southern Circle during the year were Nos. 6, 7 and 8 Parties and No. 4 Drawing Office. No. 5 Party, which was under the administrative control of the Director Southern Circle during the year, was transferred to that of the Director Central Circle from 1st April 1926.

78. *Recess work.*—32 sheets on the scale 1½ inches = 1 mile were submitted by parties to the Circle Office before the 30th September 1926, of these 8 sheets have been despatched for publication. The remaining 32 sheets surveyed on the scale 1 inch = 1 mile and 11 sheets of the Hyderābād special forest survey will be submitted to the Circle Office by parties before taking the field.

Besides the above 4 special sheets of the Mettūr Project on the scale 4 inches = 1 mile were received in the Circle Office from No. 7 Party and published copies of these 4 inch sheets were prepared in No. 4 Drawing Office.

79. No. 6 Party.—*Topographical surveys.*—This party completed an area of 5,020 square miles of original and 512 square miles of revision survey on the scale 1 inch = 1 mile in Chānda district and Bastar State of Central Provinces, Warangal, Karimnagar and Adilābād districts of Hyderābād and East Godāvari district of Madras.

PERSONNEL.

Class I Officer.

Major R. S. Wauchope, O.B.E., I.A.

Class II Officers.

Mr. E. A. Meyer, from 6th December 1925.
,, A. F. Murphy, up to 4th December 1925.
,, E. N. Natesan, B.A.
,, C. P. E. Davenport.

Upper Subordinate Service.

3 Officers.

Lower Subordinate Service.

41 Surveyors, etc.

80. An area of 5,062 square miles of triangulation was completed in Karimnagar, Nizāmābād, Adilābād, Nānder and Medak districts of Hyderābād.

81. Special survey of Sarangapalli—Tekmatla coal field for the Hyderābād government and of the Kistna Valley at Siddeswaram for the Irrigation department, Madras, and revision survey on the scale 1½ inches = 1 mile of the country around Secunderābād for the military authorities were also executed.

82. *Nature of country.*—The country under survey consists of dense forest clad hills with few open patches of cultivated areas near main rivers, like the Godāvari, Indrāvati and Prānhita.

83. No. 7 Party.—*Topographical surveys.*—This party surveyed an area of 5,740 square miles in the Anantapur, Bellary, Cuddapah and Kurnool districts of Madras, and the Raichūr district of Hyderābād. This includes the supplementary survey on the scale 1 inch = 1 mile of an area of 1,152 square miles which had been previously surveyed on the scale $\frac{1}{2}$ inch = 1 mile in season 1923-24.

PERSONNEL.

Class I Officers.

Major H. T. Morehead, D.S.O., R.E., in charge.

Lieut. G. Bomford, R.E., from 25th June to 7th October 1925.

Class II Officers.

Mr. V. W. Morton, from 17th October 1925.

Mr. J. C. St. C. Pollett.

„ N. S. Haribara Iyer.

Upper Subordinate Service.

6 Officers.

Lower Subordinate Service.

27 Draftsmen, etc.

Training Section.

15 Surveyors, etc., and pupils.

The country surveyed consisted mostly of open plains of "black cotton" soil, but intricate rocky outcrops occurred in several sheets.

Cauvery (Mettūr) survey.—At the request of the Chief Engineer for Irrigation, Madras, a detailed survey was carried out on the scale 4 inches = 1 mile of an area of 69 square miles in the Salem and Coimbatore districts, comprising the site of the proposed dam and of the proposed flooded area, in connection with the Cauvery (Mettūr) Project.

Training.—Five second-year, and ten first-year pupils received instruction during the year.

84. No. 8 Party.—*Topographical surveys.*—This party surveyed on the scale 1 inch = 1 mile, 4,764 square miles in Ahmadnagar, Sholāpur, Thāna, Kolāba, Poona and Ratnāgiri districts, 242 square miles in Bhor State, 322 square miles in Janjira State, 23 square miles in Sāngli State, 18 square miles in Mirāj (Senior) State, and 7 square miles in Mirāj (Junior) State in Bombay, and 1,633 square miles in Bhīr and Osmānābād districts in Hyderābād State. With the exception of the densely populated plains of the coast and the heavily wooded heights and foot hills of portions of the Western Ghāts, the country surveyed consisted of undulating plains mostly under cultivation.

PERSONNEL.

Class I Officer.

Major L. H. Jackson, I.A., in charge.

Class II Officers.

Mr. J. H. S. Wilson.

„ M. Mahadeva Mudaliar, M.A., up to 18th October 1925.

Mr. B. T. Wyatt.

„ M. S. Ganesa Aiyar.

„ Srinivasa Rao Kelkar, B. Sc.

Upper Subordinate Service.

2 Officers.

Lower Subordinate Service.

42 Surveyors etc.

51 linear miles of traversing were completed, and an area of 4,654 square miles was triangulated in advance for detail survey on the scale 1 inch = 1 mile in the Nilgiri, Coimbatore, Madura, Trichinopoly and Salem districts in Madras.

85. *Forest surveys.—Bombay Presidency, Northern and Central Circles.*

At the request of the Chief Conservator of Forests Bombay, an area of 30,076 acres (46·99 square miles) in the *West Nāsik* and *Poona Forest Divisions* was surveyed on the scale 4 inches = 1 mile, and in the *Kolāba Forest Division* an area of 1,223 acres (1·91 square miles) was surveyed on the scale 8 inches = 1 mile.

86. *Co-operation with the Royal Artillery.*—Points for the 12th and 16th Field Brigades were fixed at Kirkee, Hoskote and Bangalore.

IX.—SURVEY REPORTS, EASTERN CIRCLE.

DIRECTOR:—Colonel A. A McHarg, D.S.O., R.E.

87. Summary.—The parties, etc., administered by the Eastern Circle, were Nos. 4, 9, 12 Parties, No. 5 Drawing Office, and the Sadiyā Frontier Detachment. No. 12 Party did not take the field.

In addition to his duties in the Imperial Department, the Director, as Director of Surveys, Assam, held administrative charge of the Assam Survey Department including the Assam Traverse Party, the Drawing and Reproducing Offices at Shillong and the Assam Survey School at Jhālukbāri and, in his capacity as technical adviser on survey matters to the Government of Bengal, visited the Bengal Survey Office at Alipore, the Survey School at Mainamati near Comilla and the Bengal Traverse Party in the field.

88. *Training.*—All the pupils, attached for training to parties in the field, appear to be promising and likely to become useful surveyors.

Four new pupils, entertained in April 1926, were attached, for training in field and recess work, to No. 5 Drawing Office.

89. *Recess work.*—12 whole sheets on the scale 1 inch = 1 mile and parts of 21 sheets (3 on the half inch, 10 on the one inch and 8 on the 4 inches = 1 mile scales) were surveyed; of these, 2 old partly drawn one inch sheets have been completely fair-mapped and the new half inch work incorporated on another sheet; all the remaining sheets should be mapped by the time the parties next take the field.

90. No. 4 Party.—*Topographical surveys.*—This party surveyed areas of 109 and 341 square miles of original and supplementary survey respectively, on the scale 1 inch = 1 mile, in the Hazāribāgh and Mānbhūm districts of Bihār and Orissa.

PERSONNEL.

Class I Officer.

Mr. C. C. Byrne, in charge.

Class II Officers.

Mr. C. O. Picard.
Lieut. C. S. McInnes.

Upper Subordinate Service.

3 Officers.

Lower Subordinate Service.

25 Surveyors, etc.

The party, in addition, triangulated an area of 3,090 square miles in the Hazāribāgh and Mānbhūm districts of Bihār and Orissa and the Bānkurā district of Bengal and completed in the field the computing of the triangulated area originally allotted for survey. This however, owing to the long time taken in surveying the coalfield due to its intricate nature had eventually to be left over for next field season; it also completed the levelling required for the four inch survey besides making numerous connections with colliery companies' private bench-marks.

91. *Jharia coalfield survey.*—The party also surveyed on the scale 4 inches = 1 mile an area of 249 square miles comprising the Jharia coalfield in the Hazāribāgh and Mānbhūm districts of Bihār and Orissa.

Both supplementary one inch and four inch surveys were based on one and four inch reductions respectively of the sixteen inch cadastral surveys.

92. *Nature of country.*—The country surveyed, consisted of an open undulating cultivated plateau, averaging about 700 feet in elevation, drained by the Dāmodar river and its tributary the Jamuniā, dotted in the north-west by several isolated wooded hills amongst which stands out preeminently the bold forest-clad Parasnāth hill and crescent-shaped ridge, the ends of which point north-west and north-east. The summit of this hill (sacred to the Jains) is dotted with numerous small white shrines and temples, the most prominent capping the precipitous western peak (4,569 feet) of the hill, which, on clear days is visible from a distance of many miles. At the south-east end of the ridge lies the recently constructed Rājdaha reservoir, furnishing the water supply for the important railway centre of Dhānbāid and the Jharia coalfield area, in the northern part of the Mānbhūm district. The greater portion of this area is very sparsely wooded and is covered with both old and new collieries with adjacent scattered patches of terraced rice cultivation, as well as by an intricate net-work of railways and is well provided with good motorable roads, in some places lined with trees.

93. No. 9 Party.—*Topographical surveys.*—This party surveyed an area of 2,754 square miles on the scale 1 inch = 1 mile in the Cuttack, Mānbhūm and Singhbhūm districts and the Dhenkānāl, Keonjhar, Mayūrbhanj and Saraikelā Feudatory States of Bihār and Orissa; it also triangulated and traversed areas of 3,224 and 636 square miles, respectively, for one inch survey in the Mānbhūm and Singhbhūm districts and the Mayūrbhanj, Keonjhar and Nilgiri States of Bihār and Orissa and the Bānkurā and Midnapore districts of Bengal.

PERSONNEL.

Class I Officer.

Mr. B. M. Berrill, in charge.

Class II Officers.

Mr. Madras Mahadeva Mudaliar, M.A., from 20th October 1925.

Mr. Bhupendra Nath Saha, M.Sc.

Upper Subordinate Service.

4 Officers.

Lower Subordinate Service.

30 Surveyors, etc.

94. *Forest surveys.*—Areas of 4 and 437 square miles, both included in the above, were surveyed on the scale 1 inch = 1 mile in the Kolhān protected forest blocks and the Barābhūm reserved forest of the Chaibāsa Division and in the state forests of Dhenkānāl, Keonjhar, Mayurbhanj and Saraikelā Feudatory States of Bihār and Orissa respectively.

95. *Nature of country.*—The area surveyed lay in two detached portions, the smaller south-west portion includes the country, north of the Brāhmani river, where the Cuttack district and the Keonjhar and Dhenkānāl states meet, and consists mostly of high rocky precipitous jungle-covered hills rising to 3,460 feet; the larger north-east portion takes in the valley of the Subarnarekhā in the Singhbhūm district and the upper valleys of the Kadkai and Burhābalang with the northern fringe of the Simlāpāl hills, which are covered principally with *sāl* forest, rising to about 3,100 feet in the Mayūrbhanj state.

96. Sadiyā Frontier Detachment.—*Topographical surveys.*—

PERSONNAL.

Class II Officers.

Major J. H. Williams, in charge.
Mr. E. M. Kenny, from 1st December 1925 to 25th January 1926.
Mr. D. K. Rennick, M.B.E.
,, R. C. Hanson.
,, H. H. Creed.

Upper Subordinate Service.

3 Officers.

Lower Subordinate Service.

29 Surveyors, etc.

This detachment completed the survey on the scale 1 inch = 1 mile of the remaining area of 1,913 square miles, lying partly in the plains, partly along the adjacent foot-hills in the Nāgā Tribal territory and the Sadiyā Frontier tract and partly in the mountainous area, up to the Pātkai range; 663 square miles were also surveyed on the scale ½ inch = 1 mile in Nāgā Tribal territory and the Sadiyā Frontier tract of Assam. The Local Government provided Assam Military Police escorts for the protection of those surveyors working in Tribal territory and the adjacent country of the Sadiyā Frontier tract.

The detachment also triangulated an area of 1,870 square miles in the Gāro Hills and Khāsi Hills and the Goālpāra and Kāmrūp districts of Assam and carried out 272 linear miles of traversing, as far north as the frontier of Bhutān, for next year's one inch survey, over an area of 862 square miles in the Goālpāra and Kāmrūp districts.

97. *Forest surveys.*—138 square miles in the Nāmsai, Nāmphuk and parts of the Manabum and Paya protected forests and part of Dum Dumā reserved forest in the Sadiyā Forest Division and part of Dilli reserved forest of the Sibsāgar Forest Division of the Eastern Forest Circle, Assam, surveyed on the scale 1 inch = 1 mile, are included in the above details.

98. With the exception therefore, of the uninhabited upper reaches of the Dihing river (known, higher up, as the Diyun) in the Sadiyā Frontier tract, practically the whole of the north-east frontier bordering on this tract has now been covered by modern surveys, the 1 inch = 1 mile scale surveys having been connected to the quarter inch exploration surveys of the north east frontier, carried out in the years 1911-12 and 1913, and the half inch work to the south east, along the Pātkai range, having been connected to work on the same scale brought up from the Burma side.

99. *Nature of country.*—The country surveyed comprised roughly a 40 miles square in the densely wooded evergreen plains' portion of the Luhit valley south of the Luhit river, a small area of steep wooded foot-hills north of the same river, a fringe of equally steep wooded foot-hills along the eastern border and the triangular strip of forest-clad mountainous country in the south, rising from a height of about 600 feet in the plains at the Dihing river to the Pätkai Bum. The latter varies in height from 4,124 feet at the Pangsau Pass on the very rarely used foot-path, leading from Sadiyä to the Hukawng valley, to over 8,200 feet, at the south-westerly corner of the Sadiyä Frontier tract, the height of this range on the railway-surveyed route from Assam to Burma being 3,080 feet.

The few villages lying in the plains are scattered along the Tengapäni river and its tributary the Te-eng as well as up the Noa Dihing; almost all of these villages are inhabited by Hkamtis and Singphos. The only paths existing follow the general run of these minor rivers, and lateral communications, until the foot-hills are reached, are non-existent. From the Luhit river a little used Mishmi foot-path skirts the foot of the hills as far as the Te-eng river, then branches off in a south-easterly direction and eventually leads to Putao in Burma.

Wild elephants are common in the lower hills and plains. In the dry early months of the year almost all except the larger streams dry up and water becomes very scarce, but, once the rains set in, most of these streams become unfordable. Rations and transport for all the squads had to be imported and, except for one or two months during the cold weather, working conditions, owing to the prevalence of leeches and obnoxious insects, were extremely unpleasant.

X.—SURVEY REPORTS, BURMA CIRCLE.

DIRECTOR:—Lt.-Col. E. T. Rich, C.I.E., R.E.

100. Summary.—The parties, etc., administered by the Burma Circle were Nos. 10, 11, 21 Parties, and No. 7 Drawing Office.

101. *Training.*—At the beginning of the year 30 pupils were under training.

Of these 30 pupils, 8 were discharged in the spring as unlikely to become useful surveyors; the remaining 22 are promising.

In addition, 7 new pupils were enlisted during the summer and were attached to No. 7 Drawing Office for instruction in drawing.

102. No. 10 Party.—*Topographical surveys.*—This party surveyed a total area of 3,315 square miles comprising 338 square miles on the scale ½ inch = 1 mile in the tribal area between the Mali Hka and 'Nmai Hka branches of the Irrawaddy, known as "The Triangle", 2,873 square miles on the scale 1 inch = 1 mile in the Sandoway, Henzada, Bassein and Myaungmya districts of Burma and 104 square miles of forest and guide map surveys on the scales 2 & 4 inches = 1 mile.

PERSONNEL.
Class I Officer.
Captain G. Lennox, I.A., in charge.
Class II Officers.
Mr. G. A. Norman, M.B.E.
,, F. J. Grice.
Captain F. E. R. Calvert.
Upper Subordinate Service.
6 Officers.
Lower Subordinate Service.
30 Surveyors, etc.

Triangulation and traverse was also carried out over an area of 3,270 square miles in the Bassein and Myaungmya districts of Burma.

103. *Forest surveys.*—These consisted of 86 square miles in the Henzada—Ma-ubin Forest Divn. of the *Delta Forest Circle* on the scale 2 inches = 1 mile and 8 square miles on the scale 4 inches = 1 mile in the Northern Shan States Forest Divn. of the *Federated Shan States Forest Circle.*

104. *Guide Maps.*—An area of 10 square miles was surveyed on the scale 4 inches = 1 mile for the Maymyo Guide Map.

105. *Nature of country.*—The forest survey areas and country surveyed on the scale ½ inch = 1 mile consist of thick jungle-covered hills. The area surveyed on the scale 1 inch = 1 mile includes the steep densely wooded hills of the Arakan Yoma, the broken western coast line of Burma and the well cultivated plains north of Bassein. Communication in the hills is by paths and on the coast and plains by rivers and creeks.

106. No. 11 Party.—*Topographical surveys.* This party surveyed an area of 2,549 square miles on the scales 1 & 4 inches = 1 mile in the Amherst and Thaton districts of Burma.

PERSONNEL.

Class I Officers.

Mr. J. O. Greiff, in charge to 26th October 1925.

Major L. G. Crosthwait, I. A., in charge from 27th October 1925.

Class II Officers.

Mr. P. Simpson.
,, G. E. R. Cooper.
,, A. V. Dickson.

Lower Subordinate Service.

26 Surveyors, etc.

Triangulation was carried out over an area of 1,640 square miles in the Pegu, Salween, Thaton and Toungoo districts of Burma.

107. *Forest surveys.*—The following reserved forests of the *Tenasserim Forest Circle* totalling 116 square miles, were surveyed on the scale 4 inches = 1 mile:—

Thaton Forest Division.—Gyochaung, Hlaingbwe, Kyonpago, Mêlaung, Mitharaung and Tilôn Reserved Forests.

Thaungyin Forest Division.—Ta-u-kê Reserved Forest.

108. *Guide Maps.*—The town of Moulmein and environs, comprising an area of 25 square miles, was surveyed on the scale 4 inches = 1 mile.

109. *Nature of country.*—The country surveyed which lies between the Gulf of Martaban and the Siamese frontier consists partly of cultivated plains along the sea coast and Salween river, partly of low undulating forest, and partly of the Dawna range rising to over 6,800 feet and covered with evergreen forest.

110. No. 21 (Burma Forest) Party.—This party surveyed an area of 260 square miles of reserved and unclassed forests on the scale 4 inches = 1 mile in the Thayetmyo, Prome, Pegu, Toungoo, and Yamethin districts of Burma, and an area of 128 square miles of reserved forests on the scale 2 inches = 1 mile in the Yamethin district. 645 linear miles of forest boundary theodolite traverses, 3 linear miles of boundary surveys by plane-table on the scale 8 inches = 1 mile, and 75 linear miles of boundary surveys by plane-table on the scale 4 inches = 1 mile, were also completed.

PERSONNEL.

Class I Officers.

Mr. S. S. McA'Fee Fielding, in charge to 26th October 1925.

Mr. J. O. Greiff, in charge from 27th October 1925.

Class II Officers.

Lieut. L. B. Fitz-Gibbon.
Mr. H. M. Critchell.

Upper Subordinate Service.

3 Officers.

Lower Subordinate Service.

35 Surveyors, etc.

The details of this work are given below.

111. *Nature of country.*—The country surveyed consists of densely wooded hills and plains with good communications, but a great scarcity of water, which had in many instances to be obtained from some distance outside the area.

112. *Hlaing Forest Circle.*—In the *Allanmyo Forest Divn.* an area of 55 square miles was surveyed on the scale 4 inches = 1 mile in the following reserves:—Shazibo, Hmunsa, East Yoma Extensions II, III, and IV, and Pyalo.

In the *Prome Forest Divn.* an area of 98 square miles was surveyed on the scale 4 inches = 1 mile in the following reserves:—Tônyê East and West Extension, Kyatkôn, Wettaung and Extension, Kayiñeik and North Extensions, Olêzwê, Gonbalê and North and East Extensions, Sinmizwe Extension, Nyaungbindet East Extension, Pauktaw Extension, Byama-in, Myebya, Sêdaing and Extension, Zibinbla, Padinbin and Shwekyundaw. 14 linear miles of plane-table traversing on the scale 4 inches = 1 mile were done of the external boundary of the Sinmizwe and north boundary of the Tônyê reserves, and 7 linear miles of theodolite connection traversing in the Myebya and Nyaungbindet Extension reserves. The Prome Teak Plantation reserve of 0·1 square mile was surveyed on the scale 16 inches = 1 mile.

113. *Sittang Forest Circle.*—In the *North Pegu Forest Divn.* an area of 11 square miles was surveyed on the scale 4 inches = 1 mile in the Yênwê and Wami reserves, and the boundaries of four exclusions on the scale 8 inches = 1 mile, 3 linear miles in length, were added by plane-table traverse to the old survey of the Kawliya reserve.

In the *North Toungoo Forest Divn.* an area of 1 square mile on the scale 4 inches = 1 mile was surveyed in the West Swa Extension II.

114. *Central Forest Circle.*—In the *Pyinmanâ Forest Divn.* an area of 37 square miles was surveyed on the scale 2 inch = 1 mile in the Nuncho reserve, and 26 linear miles of the west boundary was surveyed by plane-table on the scale 4 inches = 1 mile.

In the *Yamethin Forest Divn.* an area of 86 square miles was surveyed on the scale 4 inches = 1 mile in the following reserves:—Hlwazin, Kôgwe, and Hlwabôn and an area of 9 square miles of unclassed forest between the Hlwazin and Kôgwe reserves was also surveyed on the same scale to show villages and communications. In the Yezin reserve an area of 91 square miles was surveyed on the scale 2 inches = 1 mile and 35 linear miles of the west boundary were surveyed by plane-table on the scale 4 inches = 1 mile 36 linear miles of interior and connection traversing was carried out in the Byingyê, Natma and Nyaunggaing reserves.

In the *Magwe Forest Divn.* 225 linear miles of boundary traversing and 50 linear miles of interior and connection traversing were carried out in the following reserves:—Myindê, Myothit, Kyaukmigyaung West Extension, Sitha, Yabe West Extensions I and II and Gyogyaung.

In the *Meiktila Forest Divn.* 239 linear miles of boundary traversing and 88 linear miles of interior and connection traversing were carried out in the following reserves:—Meiktila Fuel, Popa Hill and Extension, Pyetkaywetaung, Taunggyegôn, Sindaung, and Kubyin Extensions, I and II.

XI.—MISCELLANEOUS SURVEY REPORTS.

114. Cantonment Surveys, etc.—No. 5 Party brought the existing 64-inch scale map of Pachmarhī Cantonment up to date.

115. No. 20 Party.—This party continued field work throughout the year and completed the surveys of Rāwalpindi, Quetta with R. A. F. extension, Loralai, Fort Sandeman, Chaman and the military areas of Sunny Bank, Dungā Gali and the Military Dairy Farm in the Murree hills on the 16-inch scale, Ferozepore on the 12-inch scale, and the bāzārs of Kuldana (Murree hills) and Campbellpore on the 64-inch scale. The revision surveys of Lahore and Multān cantonments were also commenced during the year. In addition 64·49 linear miles of traversing and 11·64 miles of levelling to supply data for the detail survey were completed at a cost of Rs. 59·70 and Rs. 44·59 respectively, per mile.

PERSONNEL.

Class I Officers.

Mr. C. E. C. French, in charge to 6th November 1925.

Mr. M. C. Petters, in charge from 7th November 1925.

Upper Subordinate Service.

1 Officer.

Lower Subordinate Service.

21 Surveyors, etc.

The fair maps of Chaklāla, Mona Remount Depôt, Kohāt, Campbellpore, Bannu, Risālpur and eight * *Galis* in Murree, also the bāzār plans of Kohāt, Campbellpore and Rāwalpindi, or a total of 42 sheets, have been completed and despatched for publication.

*1. Bāriān.
2. Khaira Gali.
3. Ghora Dakka and Khanspur.
4. Chāngla Gali.
5. Cliffden and Murree.
6. Dungā Gali.
7. Kuldana, Sunny Bank & Military Dairy Farm.
8. Ghariāl and Topa.

The out-turns and cost-rates of the various classes of survey are as follows:—

Twelve-inch revision,	1,805	acres @ Rs. 0·79 per acre.
Sixteen-inch original,	1,989	acres @ Rs. 2·26 per acre.
Sixteen-inch revision,	20,000	acres @ Rs. 1·62 per acre.
Sixtyfour-inch original,	2·04	acres @ Rs. 37·47 per acre.
Sixtyfour-inch revision,	62	acres @ Rs. 18·99 per acre.

The total areas fair-mapped with cost-rates work out as follows:—

905 acres on the twelve-inch @ Rs. 0·49 per acre.
19,065 acres on the sixteen-inch @ Rs. 0·60 per acre.
241 acres on the sixtyfour-inch @ Rs. 9·27 per acre.

The section of No. 2 Drawing Office responsible for embodying on the originals and office copies of cantonment maps the changes notified annually by the Military Engineering Service was transfered to No. 20

Party on 6th April 1926, and all work connected therewith will in future be carried out by this party.

At the request of the Director General of Archæology in India, a surveyor was deputed to carry out the detail survey of the site of the anceient ruins at Mohenjo-daro in Lārkāna district in Sind on the scale of 100 feet to an inch. An area of 394·17 acres was accordingly surveyed in detail with the necessary traversing and levelling required for the frame work. The expenditure of Rs. 1296-14-0 is debitable to the Archæological Department.

116. Bhopāl survey.—During the year the detachment continued the work of traversing village boundaries and the interior sub-demarcations for the cadastral survey of the Bhopāl State on the scale 16 inches = 1 mile.

Except five computers and traversers lent by the Survey of India Department, all other hands, 68 in number, were entertained and many of them were trained as in previous years. The work was based on G. T. and topographical triangulation stations existing in and around the area traversed.

In all 6,307·8 linear miles of main and sub-circuit traverses were run and 43,300 theodolite stations were laid out in an area of 2,194·4 square miles, along the boundaries and interior of 1,051 villages. 5,645 theodolite stations around village trijunctions were demarcated by monolith pillars 2 feet by 6 inches to serve as bases for future survey and demarcation of fields and boundaries. Origin co-ordinates of the stations marked with stones falling in 1,051 villages were reduced and copied. 2,435 *musāvis*, (settlement maps) on the scales 16 and 4 inches = 1 mile were plotted. The area of 8 main-circuits, 81 sub-circuits, and 1,051 villages was computed by universal theorem and that of the villages by planimeter as well and compared *inter se*. 124 four inch sheets were reduced on the scale 1 inch = 1 mile by pentagraph. 40 miscellaneous traces were prepared.

117. *Cadastral survey.*—In the middle of September 1925, the Settlement Officer in charge of this party having resigned, the Officer in charge was asked by the Revenue Member to take charge of it in addition to his own duties.

The programme consisted of cadastral survey on the scale 16 inches = 1 mile and preliminary record-writing (both field and recess) of eleven tahsils, an area of about 2,900 square miles. The field work had to be commenced on 1st October 1925, and the strength sanctioned for it was 2 assistant settlement officers, 4 head inspectors, 16 inspectors,

and 173 amins, but on account of the incomplete arrangements made by the outgoing officer, neither the full number of amins nor the instruments necessary for the work were forthcoming at the end of September 1925. Accordingly, though the field work was started on the due date, only two camps could then be formed to take the field instead of four as proposed. The two assistant settlement officers were entertained in November and December 1925, and gradually, as the amins arrived, the two remaining camps were also formed by the end of December 1925.

The field operations continued till the middle of July 1926, and an area of about 2,100 square miles was surveyed on the scale 16 inches = 1 mile. The record-writing of 973 villages of tahsīls Sehore, Ichhāwar, Jāwar, Ashta, Durāhā, Nasrullaganj, Bilqīsganj, Goharganj and Diwānganj was completed in the field. The detail survey was checked by 3,322 linear miles of *partāl*, of which the check by the superior agency amounted to 498 linear miles. 23 per cent of the quadrilateral lines, on which the detail survey was based, were also checked on the ground. Besides this, about eight villages in each tahsīl, except in Nasrullaganj and Durāhā tahsīls, were checked by the Secretary, Revenue Department, in the field.

The area under traverse survey was mostly hilly and covered with thick forests but in parts it consisted of well cultivated plains. The nature of the ground under cadastral survey was undulating and interspersed with isolated hillocks covered with jungle. The Vindhya Chal Range bounded the area on the south.

The office work of the Traverse Detachment and field and office work of the Cadastral Survey Party was inspected by the Director Geodetic Branch from 16th to 19th March 1926.

118. Commercial levelling.—Besides the geodetic levelling referred to on p. 16 and the work of the Sutlej Valley Irrigation Project referred to in the next paragraph No. 17 Party carried out the following:—

PERSONNEL.

Class I Officers.

Major A. H. Gwyn, I.A., in charge up to 31st March 1926.

Major V. R. Cotter, I.A., in charge from 1st April 1926.

Class II Officers.

Mr. N. R. Mazumdar.

,, J. L. Sahgal.

Upper Subordinate Service.

7 Officers.

Lower Subordinate Service.

22 Computers, etc.

64 purely temporary Levellers, etc.

(*a*) Secondary levelling for the Chief Engineer, E.I.R., in Bengal, Bihār and Orissa, and the United Provinces, mainly along the railway line.

(*i*) Barākar—Allahābād.

(*ii*) Mughal Sarai—Hazāribāgh.

119. *Sutlej Valley Levelling.*—The following was done including the completion of all levelling work for this project :—

(*a*) Secondary levelling—

(1) In Sind	69	miles.
(2) Near Panjnad Weir Site ...	59	,,
(3) In Haveli Project	132	,,

(*b*) Tertiary levelling—

For Sutlej Valley Irrigation Project ... 3,852 Sq. ,,

The country was less favourable for economical work than during the previous year owing to, (*a*) lack of water in some parts, (*b*) high sand hills in the desert areas, (*c*) a number of overflow channels in the watered areas which had to be constantly crossed and re-crossed.

APPENDIX.

The Centenary of the death of Col. Valentine Blacker, C.B.

A photogravure of Col. Valentine Blacker, C.B., the first Surveyor General of India 1823-1826 forms the frontispiece to this report. The 4th of February 1926*, the centenary of this officer's death, was suitably commemorated by the Surveyor General, who, with a few senior officers visited Col. Valentine Blacker's grave in the Park Street Cemetery, Calcutta, and placed a wreath thereon. The great topographer Major James Rennell, who was Surveyor General of Bengal from 1764 to 1777, claims to have been accorded the title of Surveyor General of India in 1767, but this title does not seem to have been regularly accorded to any of his successors and was only permanently established when Col. Valentine Blacker became the first Surveyor General in 1823.

This year is also memorable in the annals of the Survey as being that in which Col. Lambton, the first founder and Superintendent of the Great Trigonometrical Survey, died at the age of 70, when still working in the field and was succeeded by Lieut. Everest who afterwards became Col. Sir George Everest and Surveyor General of India. It was thus in 1823 that the title of Surveyor General became permanently established, and that the officer, who was to organize the great framework of the Trigonometrical Survey on its present lines, assumed the office of Superintendent. Col. Valentine Blacker is believed to have fully appreciated the value of a proper basis of triangulation of a high order of accuracy for the whole Survey of India, as is shown by an able paper of his on the subject which was reprinted by Major General Sir Andrew Waugh.

Sir Andrew Waugh speaks of Col. Valentine Blacker as, with the exception of Everest, the ablest and most scientific man that ever presided over the department.

---

* The date of Col. Valentine Blacker's death was the 4th of February 1826, as is authenticated by the records of the Park St. Cemetery in Calcutta, where he is buried and by the inscription on his monument. His death is said to have been due to an accident. The Dictionary of Indian Biography by C. E. Buckland, C.I.E., 1906, and the Dictionary of National Biography by Leslie Stephen and Sidney Lee, 1908, give the date of his birth as October 19, 1778 which is possibly correct, but give the year of his death wrongly as 1823. Markham, in his memoir on the Indian Surveys states that Col. Valentine Blacker died of fever in 1827, but this statement also appears incorrect, both as regards the year and cause of his death.

The revenue surveys in the N. W. F. Province were commenced under his auspices. The authorship of a lithographed pamphlet entitled "Construction of a graticule for a general Atlas of India" is attributed to Col. Blacker by Markham, and, though the actual name of the author does not appear on the pamphlet, nor the date of its production, it appears from an old letter of Major General Waugh's that this is correct.

The projection that he suggested was a polyconic one and differed from that actually adopted by the geographer at the India Office, London, for the Atlas of India.

The calculations for Col. Valentine Blacker's projection were most carefully made and tabulated in a more convenient form for use than was actually the case with the Atlas projection. Moreover his central meridian and parallel (20° latitude 80° longitude) were more symmetrically placed than the central parallel and meridian ($24\frac{1}{4}$° latitude $76\frac{1}{2}$° longitude) of the Atlas.

The polyconic projection was thus Col. Blacker's gift to India, though his exact projection was afterwards modified by General Walker, In 1906 the Survey Committee abandoned the Atlas sheet projection, which was defective, and brought the $\frac{1}{4}$ inch = 1 mile maps on to the polyconic system. It may be thought that Col. Blacker had the assistance of mathematical specialists in dealing with map projections, but this was not the case. The East India Company's officers, Lambton chosen from the Infantry, Everest from the Artillery, and Blacker from the Cavalry had to be their own specialists.

The following record of the services of Col. Blacker has been compiled from such biographies as are available, supplemented by information obtained from a relative.

Lieut.-Col. Valentine Blacker (1778 to 1826), historian of the Mahratta war of 1817—1819, served in the Madras Cavalry in 1798, and as cornet with a troop of the Nizam's contingent in the Mysore campaign of 1799. The next year he was employed as A.D.C. to Col. Stevenson in the Wynaad and then served with his regiment in the south of Madras under Col. Agnew, when he was thanked in despatches for surprising the enemy and successfully charging them with his troop. He then joined the Quartermaster General's department (Madras), rising to be Quartermaster General in 1810 at the age of 32. In 1815 he served with the army of reserve under Lt.-Gen. Sir Thomas Hislop and in 1817 under the same commander with the army of the Deccan at the battle of Mahidpur and other operations of that year. His services at Mahidpur and the reconnaissance made by him before the battle were

specially brought to the notice of the Governor General. On returning to Europe in 1821, he was thanked in general orders by the Commander in Chief of the Madras Army for his eminent and scientific services as Quartermaster General of the Army of Fort St. George during a period of ten years.

His distinguished career in Madras appears also to have been commemorated by the application of his name to Blacker's Garden, a residence in that city.

He was then appointed Surveyor General of India, when he executed a complete map of Hindustān, still preserved by his family at Elm Park, Co. Armagh. Besides introducing the polyconic projection into Indian mapping, he initiated the first explorations of the Dihang and Dibang.

Syed Mohsin, the celebrated mathematical instrument maker, was first trained under Col. Blacker, who took him to Calcutta from Arcot. Col. Blacker was appointed a C.B. in 1818 and died at Calcutta on the 4th February 1826 as the result of an accident.

His monument bears the following inscription :—

Epitaph (on the front).

Beneath are deposited the remains of Lieut.-Colonel Valentine Blacker, Companion of the Bath, of the Light Cavalry, on the establishment of Fort Saint George.

During ten years Quartermaster General of the Madras Army and subsequently Surveyor General of India.

Ob iv February MDCCCXXVI Act. XL.

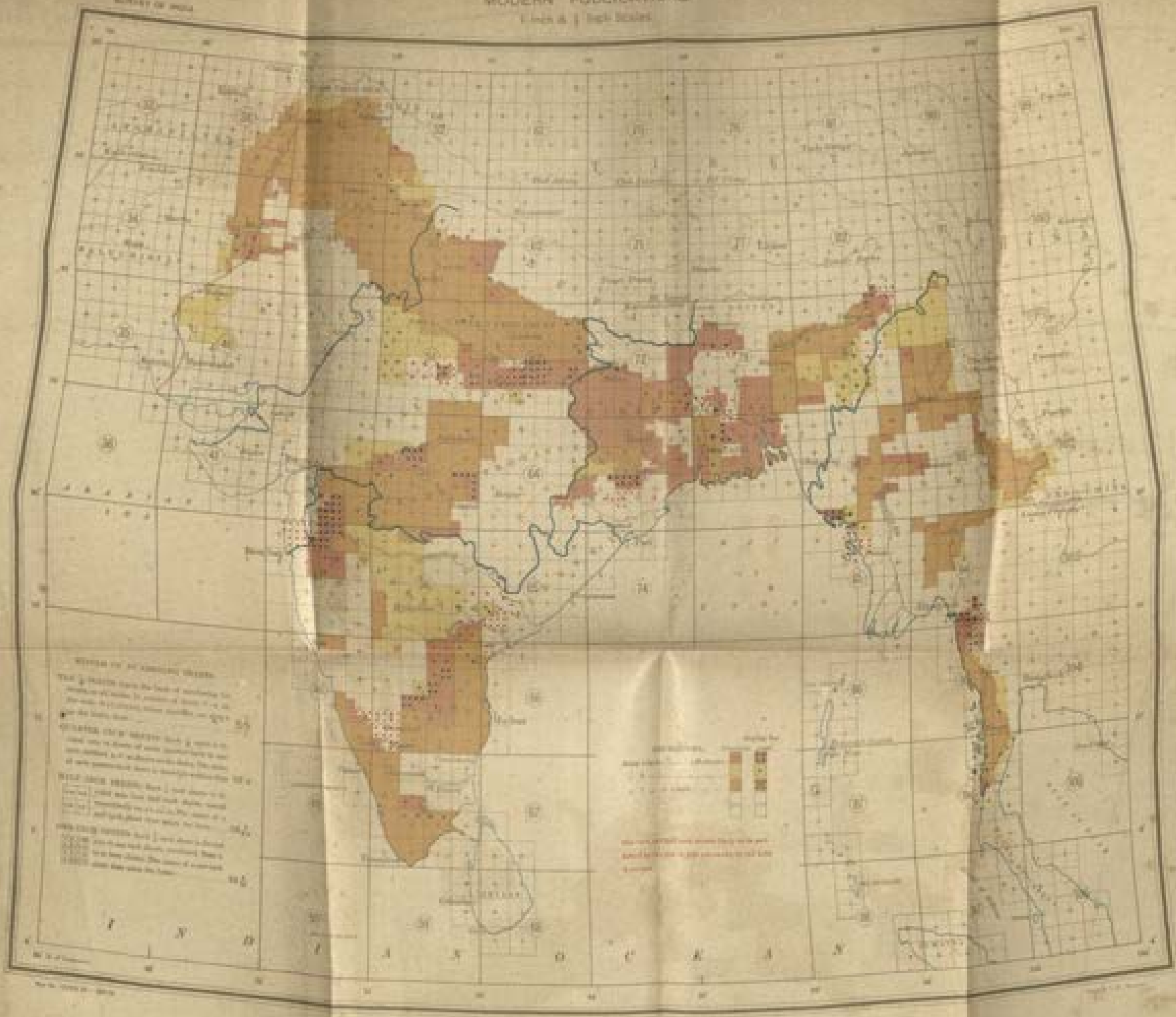
(On the opposite side).

Lieut. Col. Blacker was an officer distinguished alike for professional ability, for public zeal, for private worth and for manliness of character. In testimony thereof his friends and comrades have caused this monument to be erected to his memory.

SURVEY OF INDIA

MODERN PUBLICATIONS

1 inch & ¼ inch Scales

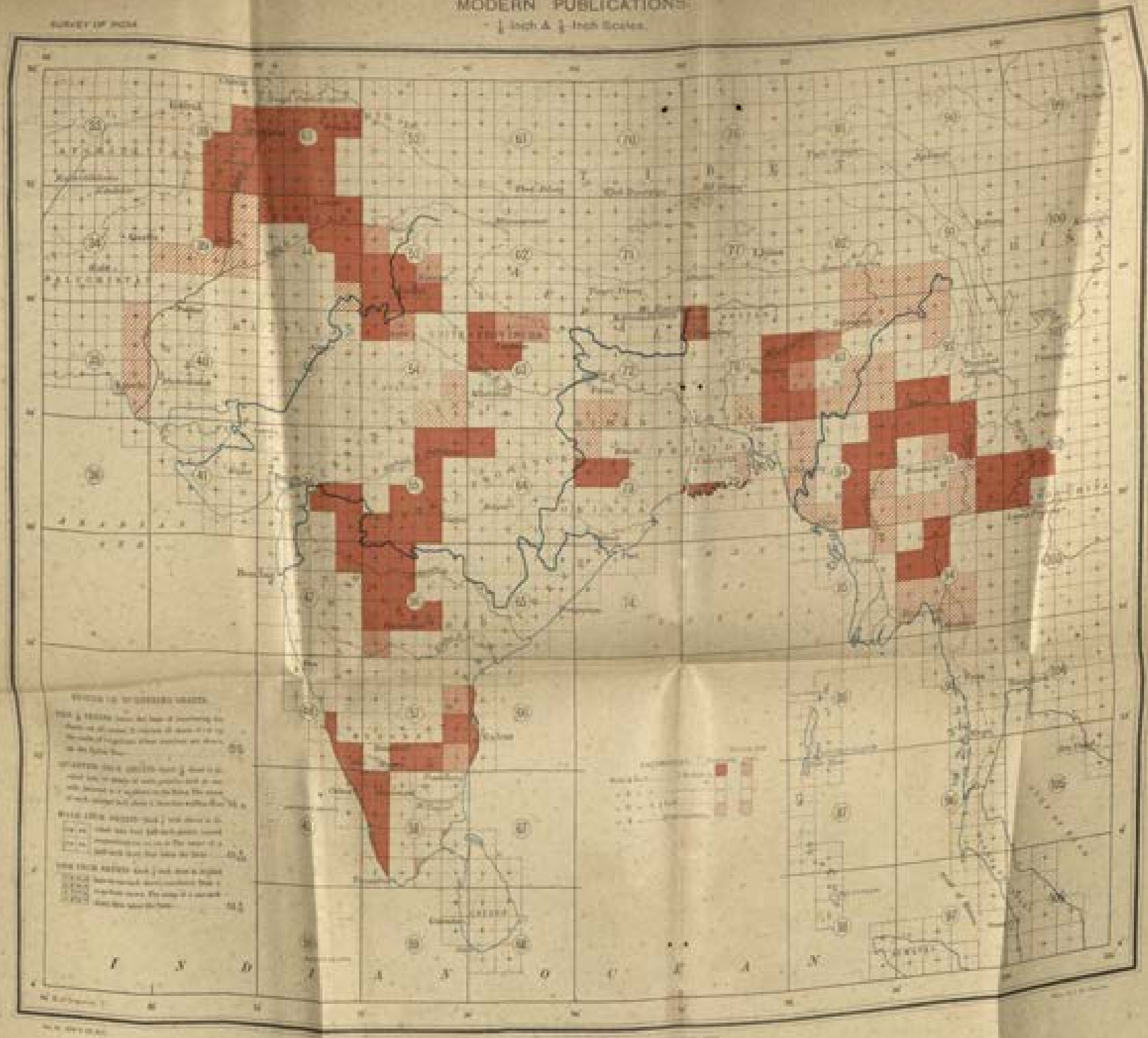


MODERN

1-Inch A

MODERN PUBLICATIONS

1 inch & ½ inch Scales.



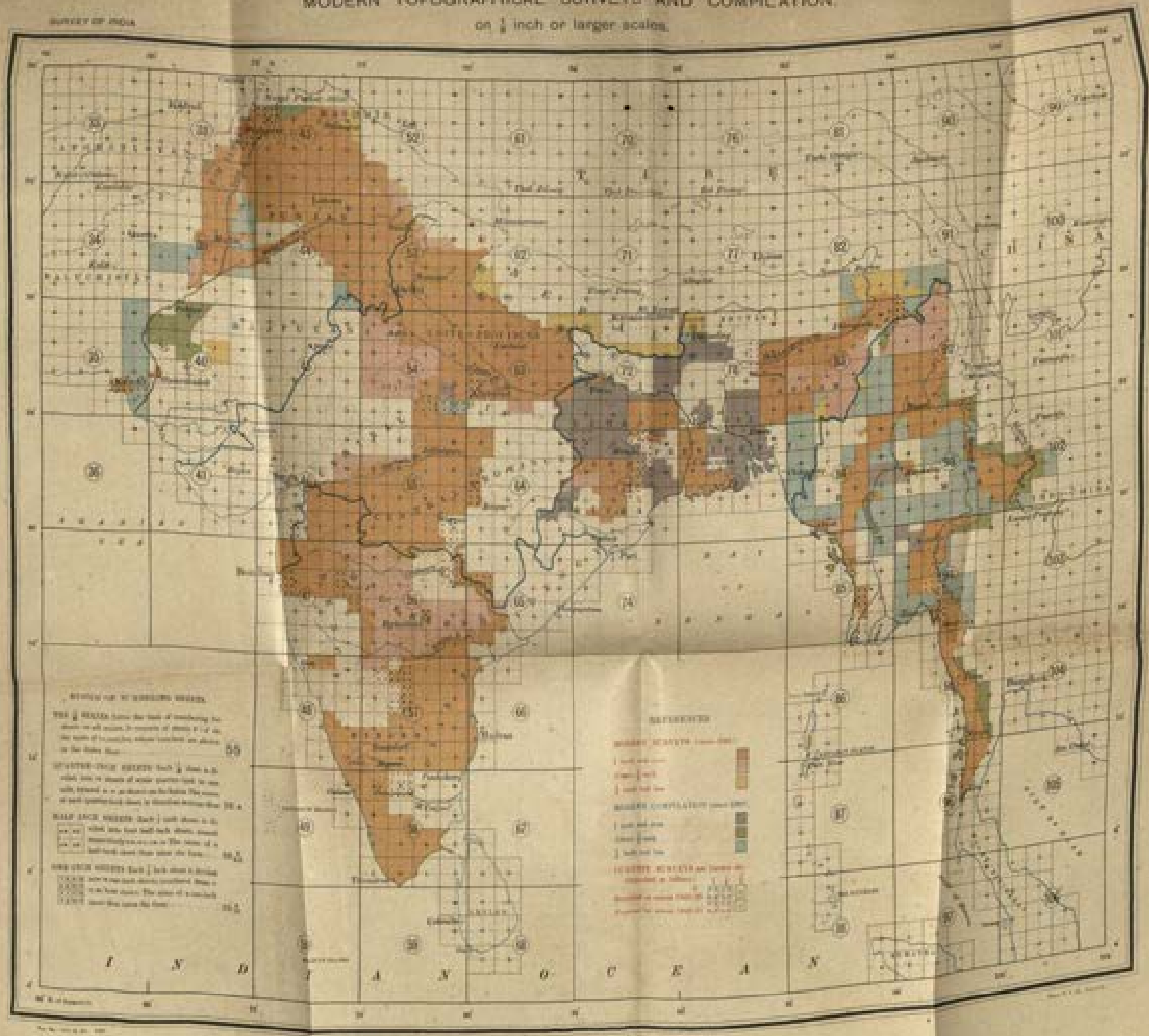
MODERN PU

¼-inch & ½

SURVEY OF INDIA

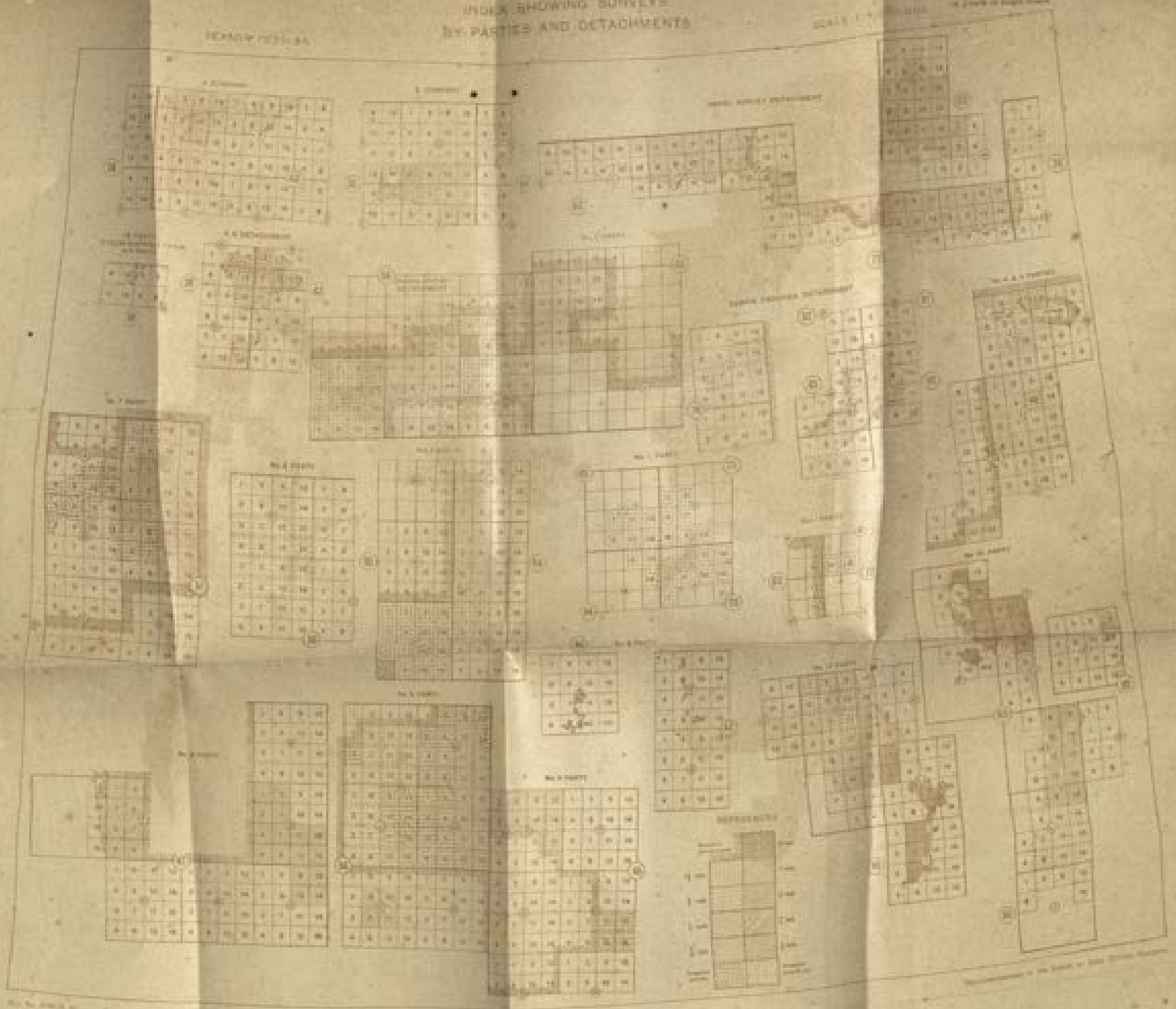
MODERN TOPOGRAPHICAL SURVEYS AND COMPILATION

on $\frac{1}{4}$ inch or larger scales.



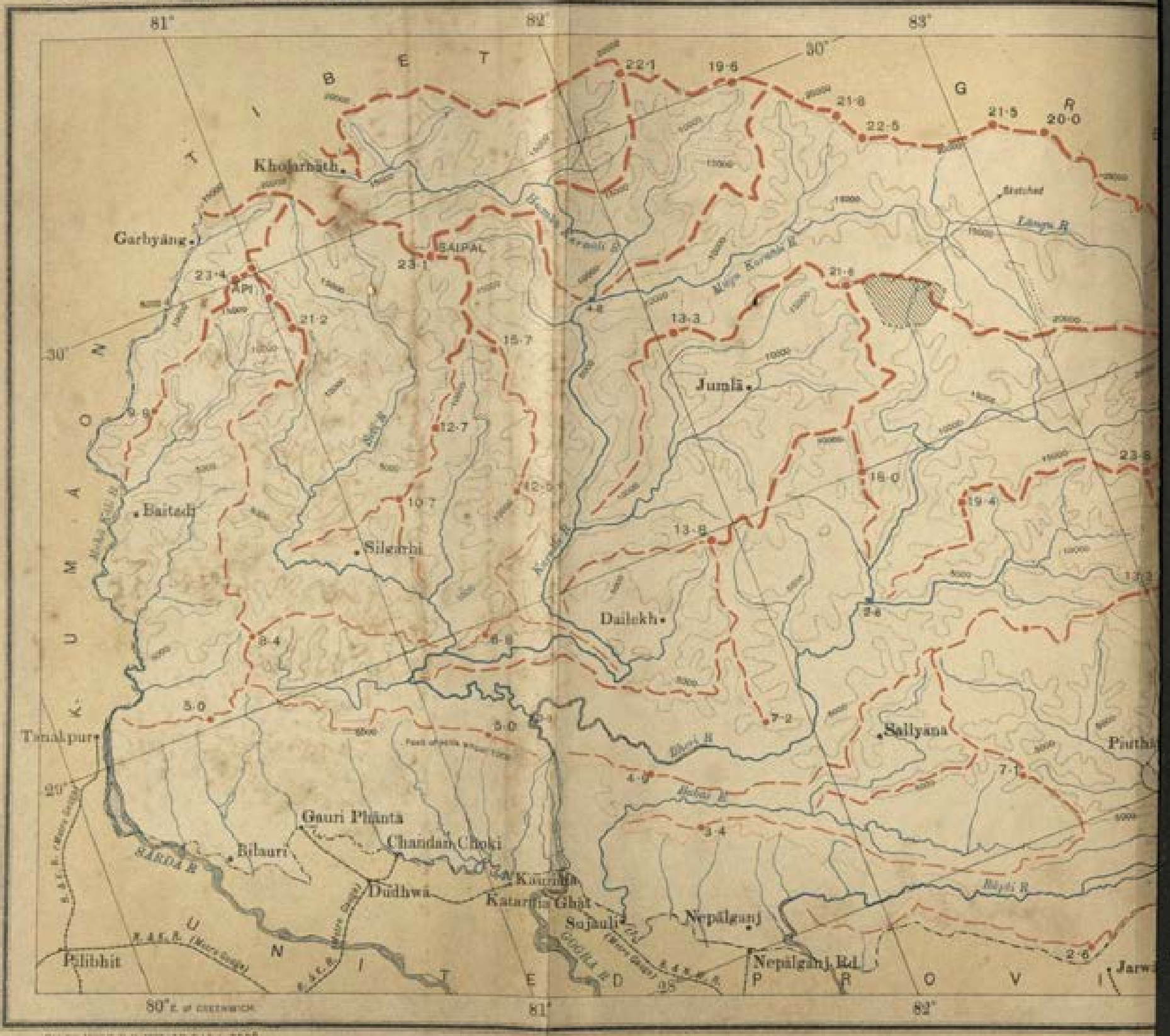
INDEX SHOWING SURVEYS
BY PARTIES AND DETACHMENTS

MODERN TOPOGRAPHICAL SURVEYS AND COMPILATION



SKELETON MAP OF NEPÁL
KATMANDU

SKELETON MAP OF NEPÁL



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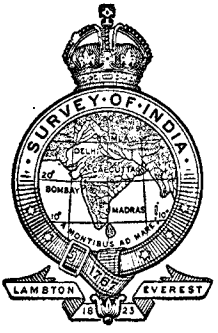
For Publication with the General Report of the Survey of India for 1926-27 (Vide Appendix B)

SURVEY OF INDIA

GENERAL REPORT

1926 TO 1927



LIBRARY OF THE BOMBAY BRANCH OF THE ROYAL ASIATIC SOCIETY

From 1st October 1926
To 30th September 1927

PUBLISHED BY ORDER OF

Colonel Commandant E. A. TANDY, R.E.,

SURVEYOR GENERAL OF INDIA.

Printed at the Photo.-Litho. Office,
Survey of India,
CALCUTTA,
1927.

PREFACE.

THE WORK OF THE SURVEY OF INDIA.

The department is primarily responsible for all topographical surveys and explorations, and for the maintenance of geographical maps of the greater part of Southern Asia. Also for geodetic work, which includes:—the main trigonometrical framework, extending in some cases far beyond the frontiers of India, and control networks of precise levelling based on tidal observatories; tidal predictions and the publication of Tide Tables for nearly 40 ports between Suez and Singapore; the Magnetic Survey; astronomical, seismographic, and meteorological observatories at Dehra Dūn; and geodetic investigations of an international character, in regard to which India enjoys a unique position between the greatest highlands of the world and a deep ocean extending to the Antarctic. Indian geodesy has thus disclosed by far the largest known anomalies of gravitational attraction in the earth's crust, and these have led to some of the most important developments of modern geodetic research, whilst the Great Trigonometrical Survey of India enjoys an international reputation as a very valuable contribution to estimates of the size and figure of the earth. The calculations of astronomy and some important data in physics depend ultimately on these terrestrial measurements.

In the past the department has also carried out the original large-scale revenue surveys for most of India, and was still conducting this work for Central and Eastern India and Burma up to 1905, when all revenue surveys were handed over to the Provinces concerned, together with officers and staff as required, in order to concentrate the energies of the department on a complete new series of modern topographical maps on the scale of 1 inch to 1 mile. It was hoped to complete this series by 1930, but owing to retrenchment and the war little more than half has been done up to date, in spite of the reduction of the scale of survey for less important areas. Thus, although new surveys covering an area about equal to that of England are carried out every year, the maps of half the country are still very old and only kept up to date roughly by means of rather perfunctory information supplied by local officials; the old maps are also about 2 miles out of position, being based on a longitude of Madras determined in 1815.

Boundary surveys and records of international, state, and provincial frontiers have always formed an important item of topographical work; and in recent years there has been considerable progress in the preparation of Guide Maps for important cities and military stations, where the one-inch scale is quite inadequate.

Miscellaneous. While expending on topographical and geodetic work all funds alloted by Imperial Revenues, the department is steadily developing the policy of aiding local surveys in various ways, on payment by those concerned. These miscellaneous operations include: all forest and cantonment surveys: many riverain, irrigation, railway, and city surveys, and surveys of tea gardens, mining areas, &c., with a great deal of control levelling for the same; administrative assistance and officers are also given in aid of the revenue surveys of various Provinces and States. The Printing offices do much work for other Government departments, such as printing special maps, illustrations for Archeological Reports, all diagrams for Patents, &c. The Mathematical Instrument Office gives valuable aid to all Government departments by ensuring a high standard of instrumental equipment, especially in connection with optical work and by the manufacture and repair of high-class instruments which would otherwise have to be imported from abroad.

Military, &c. The department is also responsible for all survey operations required by the Army, and has been rapidly developing measures to meet the greatly increased complexity of modern military requirements, especially in connection with air survey. In view of its high military importance, air survey work for various civil purposes is receiving all possible encouragement and assistance, while the latest methods of stereo-photography are being studied experimentally.

Administration is by the Surveyor General under the Education, Health and Lands Department of the Government of India. The Headquators Office is at Calcutta under the Assistant Surveyor General, and there are seven Directors, one for each of the five Survey Circles into which the country is divided, one for the Geodetic Branch at Dehra Dūn, and one for the Map Publication and other technical offices at Calcutta.

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SURVEY OF INDIA

GENERAL REPORT

1926 TO 1927

From 1st October 1926
To 30th September 1927

INTRODUCTION AND SUMMARY.

1. Annual Reports.—Annual Reports are now published in three separate volumes as follows:—

General Report.
Geodetic Report.
Map Publication and Office Work Report.

The first two are for the survey year ending 30th September but the last is for the financial year up to 31st March.

The Map Publication Report contains *all the index maps* showing the progress of map publication on all scales, with reports on publication and issues, printing and drawing, and of such offices as the Mathematical Instrument Office, which have to conform with the financial year.

The Geodetic Report includes full details of all scientific work.

This General Report only gives brief abstracts of the above (*vide* Abstracts II and III in the Table of Contents) but gives complete reports of the survey operations of the ordinary field parties and detachments. Abstracts I and IV (*vide* Table of Contents) summarise these latter reports and enable the reader to look up such portions as may concern him. There is one index map at the end, showing the progress of modern topographical surveys and compilation. Maps of sorts are of course available for all parts of the Indian Empire, but some are very old, and all previous to 1905 were based on the old longitude of 1815, (which was over 2 miles out), and are excluded from the index map.

2. General. Colonel Commandant E. A. Tandy, R.E., returned from leave and took over the post of Surveyor General from Colonel C. P. Gunter, O.B.E., R.E., on the 19th November 1926.

The post of Assistant Surveyor General was filled by Major C. M. Thompson, I.A., up to 14th April 1927, and afterwards by Major W. E. Perry, M.C., R.E.

3. *The total cost* of the Department for the past financial year ending 31st March 1927, as compared with that of previous years, was as follows:—

	1924-25	1925-26	1926-27	REMARKS.
	Rs.	*Rs.*	*Rs.*	The increase in net charges is chiefly due to changes in accounting and purchase of buildings, etc.
Gross actual cost ...	53,66,784	64,11,135	56,65,658*	
Deduct receipts and credits	22,27,138	21,60,926	23,20,585*	
Net actual charges ...	31,39,646	32,50,209	33,45,073*	

*These figures are not final.

The total area of new surveys of all kinds completed during the year was 58,210 square miles (p. 24).

4. *Organization.* The whole area of India and Burma is divided for the purposes of the Survey of India into five Circles. The limits of these are shown by blue lines on the index map at the end of the book. In order that civil administrations and the public may know which Director to address on survey matters a list of Provinces and States comprised in each Circle is given in the loose slip containing Survey Notices.

The designation of Officer-in-charge of the Mathematical Instrument Office, Calcutta, has been changed to 'Superintendent' and those of the Works Manager and the Assistant Manager of the office have been changed to 'Assistant Superintendents'. All these three posts are now of gazetted status.

A most interesting Survey Museum has been started in the Geodetic Branch Office at Dehra Dūn, and better accommodation has also been provided for the Training School; this centre has now become an excellent place for young officers of all ranks to get a good impression of our records and traditions during the past century, when they report here for their first training.

As neither *A* nor *E* Company of the Frontier Circle recess at the Circle headquarters it was found necessary to form permanent drawing sections in both these companies from 1926 to help their fair mapping and make the units more complete.

Reproducing Sections were formed in October 1926 with *E* Company at Quetta and with No. 18 Party at Peshāwar to meet the local demand

for reproduction work and to increase the power of mobilisation of *A* and *E* Companies.

No. 24 (Sind Rectangulation) Party was formed from 1st October 1926, under the administration of the Frontier Circle, to undertake the Rectangular Survey of the Lloyd Barrage area (Sind) for the Bombay Government.

5. Notable events of the survey year were as follows:—

The first modern Survey of Nepāl, commenced in 1924, was completed in March 1927. A brief account of the work will be found in Appendix II of this Report and the main geographical results are shown in the Frontispiece.

Turco-'Irāq Boundary Commission. The Survey, including photo-survey with the Wild photo-theodolite lent by the Royal Geographical Society, was carried out by a Survey of India detachment during the summer of 1927. This consisted of Major Lewis, R.E., in charge, with Mr. Muhammad Hasan, Sub-Assistant Superintendent, five surveyors and twenty-eight khalasis.

North West Frontier Province. Topograpical surveys were completed of the hitherto closed areas of Swāt and Dīr, and further extensions of work in this important neighbourhood are in hand (pp. 36).

Exploration. The expedition under Major Mason, which set out in April 1926 to explore the Shaksgam Valley and Aghil ranges, beyond the Karakoram, closed work in October 1926 and returned in November (pp. 86).

Surveyor Torabaz Khan was deputed to accompany the exploring party of Mr. H. F. Montagnier of the Alpine Club with a view to connecting the work of the Visser expedition of 1925 to that of Major Mason noted above (p. 88).

The fundamental longitude of India was re-determined by the Dehra Dūn Observatory as part of an international scheme for the determination of precise longitudes, in which 40 leading observatories of the world took part. The result is in close agreement with that reached by very laborious operations over 30 years ago (p. 11).

Geodetic Congress. Lt.-Colonels M. O'C. Tandy and R. H. Thomas represented the Survey of India at the Third Congress of the International Union of Geodesy and Geophysics held at Praha (Prague) from 30th August to 10th September 1927.

Twenty-three countries, represented by 195 delegates, attended the Congress. Dr. Bowie, Director of the Coast and Geodetic Survey, U. S. A., as President of the Section of Geodesy, eulogised the past

work of the Survey of India, remarked on the great international importance of its work, and expressed the interest which all geodesists would take in its future operations.

Considerable interest was expressed in the recent investigations by Dr. de Graaff Hunter regarding the Figure of the Earth.

An Air-Survey Committee consisting of officers of the Royal Air Force, General Staff and Survey of India, and the Director of Civil Aviation, has been formed to collect information and to watch developments in air-survey, both civil and military, in all parts of the world and to act as advisers to the Government of India, Local Governments and Indian States, on all questions connected with air-survey. The first meeting of the Committee was held at Dȇlhi in March, 1927.

An F.8 Air-Photo Camera has been purchased for use in Air-Surveys.

Manœuvres. A Survey Section from *E* Survey Company was attached to the Western Command Manœuvres, 1926. A Section from *A* Survey Company was attached to the Tactical Exercise of Northern Command 1926 to co-operate with a Royal Artillery Survey Section.

Adventures and Casualties. Burmese dacoits near the Siam frontier attacked a party of four khalasis, who were in charge of money, killing two and very seriously wounding the other two. The Burma parties (Nos. 10 and 11) lost fifteen men from cholera, while a khalasi of No 10 Party was killed by a wild elephant and a mule-driver in 11 Party by a tiger. Work in the Eastern Circle was occasionally enlivened by wild elephants and tigers, and in No. 1 Party's area man-eating tigers were a serious menace, fourteen villagers being killed by them during the period of survey.

New buildings. The Bonnie Brae Estate in Shillong has been purchased for offices for the Eastern Circle. The building vacated by the office of the Controller of Military Accounts in Quetta was purchased from the Army Department as an office for *E* Survey Company (Frontier Circle).

Officers on leave have done much useful work in studying modern developments of various kinds. Lt.-Colonel Hamilton, and Majors Mason, Slater and Jackson were deputed, while on leave at home, to visit Government offices and firms in England, France, and Switzerland, in order to study the latest improvements and processes in photogrammetric, stereographic and air survey, as well as modern methods of reproduction and other matters at the Ordnance Survey, Southampton. Lt.-Colonel Hamilton also investigated Artillery Survey developments at Larkhil

and attended the combined Naval, Military and Air Force Survey Exercise in Scotland, and has supplied very full and valuable reports on all the above.

Major Meade underwent a course of instruction in air-photo survey at the School of Photography, Farnborough, and produced a very good report illustrated by diagrams and photographs.

Major Lewis was employed by the High Commissioner in England on work connected with the revision of maps for the *Imperial Gazetteer of India*, and Captain Glennie completed the standardization of the four half-second pendulums.

Messrs S. Colquhoun and C. F. Oddy, Managers, Photo. Litho. Office, also visited certain firms in England and Scotland and the Ordnance Survey Office, Southampton, to gain experience of the latest developments in map reproduction.

6. Appreciations.—Major Lewis has received the following appreciation of the work of his party on the Turco-'Irāq Boundary Commission from the acting Prime Minister of 'Irāq:—

"On the completion of the work of the Frontier Delimitation Commission I have great pleasure in asking you to accept my warmest thanks and congratulations for the excellent work performed by you and your party."

"The 'Irāq Government desire to express to you their appreciation of the remarkable services which you have rendered to 'Irāq."

The Assistant Commissioner, in charge of the Mysore—South Kanara Boundary Settlement in 1924-25, in his Report to the Madras Government has made special reference to the good work of Mr. V. W. Morton and surveyor Mokham Chand when nearly all the survey staff were down with malaria and had to face special difficulties.

In the Annual Report for the year ending 31st July 1926, Mr. R. M. Crofton, I.C.S., the Settlement Officer, Melghāt Settlement operations in the Central Provinces, has expressed his high appreciation of the traverse work conducted by Mr. N. N. Chukerbutty in a remote and difficult tract.

Sir Aurel Stein, K.C.I.E., Ph.D., D.Litt., D.Sc., has expressed his keen appreciation of the valuable services rendered by Mr. A. T. Brendish who accompanied him as photographic assistant in his recent explorations in Baluchistān. He has also specially commended the excellent work done by Surveyor Torabaz Khan who accompanied him in his expedition to the Upper Swāt Valley in 1926, and has placed on record his appreciation of the remarkable zeal, energy and skill displayed by

this surveyor in the execution of his work. Mr. H. F. Montagnier, with whom Torabaz Khan was exploring this year, has also written in high praise of his work.

7. Awards.—His Majesty the King approved the award of the Founder's Medal of the Royal Geographical Society to Major Kenneth Mason, M.C., R.E., for his connection between the surveys of India and Russian Turkistān through the Pāmīrs in 1913, and his organization and conduct of the Shaksgam Expedition of 1926.

The Governor General in Council was pleased to sanction the grant of the *Indian Distinguished Service Medal*, to Surveyor Mir Abdullah, Survey of India, attached Air Headquarters, 'Irāq, for distinguished service, exceptional zeal and devotion to duty in survey work, while serving with military columns operating in 'Irāq and Kurdistān during 1926.

The Arthur ffolliott Garrett Prize for 1926 was awarded by the Council of the Institution of Royal Engineers to Captain G. F. Heaney, R.E., for his essay "Survey on Active Service."

His Excellency the Governor General of India has been pleased to confer the Volunteer Officers' Decoration upon Mr. B. T. Wyatt who is a Lieutenant in the Bangalore Battalion of the Auxiliary Force.

8. Personnel.—Casualties, retirements, and recruitments were as follows:—

Class I Officers:—Mr. J. O'B. Donaghey died. Mr. H. W. Biggie retired.

Mr. B. M. Berrill was confirmed as Superintendent, Captain G. W. Gemmell, I.A., and Lieuts. D. M. Burn, R.E., and I. H. R. Wilson, R.E. were appointed to the Department.

Messrs H. P. D. Morton, P. A. T. Kenny, O.B.E., and Major J. H. Williams from Class II were promoted to fill temporary posts in Class I Service.

Class II Officers:—Mr. E. C. O'Sullivan, D.C.M., died while on foreign service in 'Irāq. A competitive examination for the recruitment of 7 probationers to the Class II Service was held at the various Survey headquarters in September; 72 candidates were nominated to sit for examination by the Selection Boards.

Upper Subordinate Officers:—Mr. B. Batabyal died. Four Lower Subordinates were promoted to the Upper Subordinate Service and fourteen probationers were appointed in October 1926, of whom four have resigned.

I.—ABSTRACT OF SURVEYS IN EACH PROVINCE AND STATE.

9. The annual expenditure of surveys in the Indian Empire must amount to something like three crores of rupees, or say two million pounds, if we include cadastral surveys, carried out locally by Provinces and States, and miscellaneous surveys for engineering projects, *e.g.*, railways, canals, mines, roads, rivers, harbours, cities, &c.

The prime duties of the Survey of India are geodetic, topographical and geographical, and cost little more than a tenth of this total (about Rs. 33,00,000); but the department is also developing co-operation with local survey agencies, with a view to mutual economy, and is now doing miscellaneous outside work costing nearly Rs. 30,00,000, on payment by those concerned, besides advising and co-operating in other directions and lending officers to Provincial Surveys as required. The following abstract shows the nature and *locale* of the field operations actually carried out by the Department during the past year, grouped under the following sub-heads :—

Air Surveys.	Riverain Surveys.
Exploration.	Boundary Surveys.
Topographical Surveys.	Geodetic.
Forest Surveys.	Framework.
Cantonment and City Surveys.	Levelling.
Cadastral Surveys.	Miscellaneous.
Railway Surveys.	Training.

10. N. W. F. Province and Kashmīr.

Exploration in Shaksgam Valley, Aghil Range, Kashmīr State (p. 86) and in Hunza State (p. 88).

Topographical surveys in Dīr, Swāt and Chitrāl, Khyber Agencies, Tribal territories and Peshāwar district (p. 37).

Forest surveys in Hazāra Division (p. 37).

Cadastral and boundary surveys in Peshāwar district (p. 48).

Framework, triangulation in Dīr, Swāt and Chitrāl (p. 37); in Kashmīr State (p. 37). Traverse and triangulation in Peshāwar district for Settlement Surveys (p. 48).

Miscellaneous, Upper Bāri Doāb Canal survey, Kashmīr State (pp. 56, 57).

11. Baluchistān.

Topographical surveys in Las Bela State (p. 40).

Cantonment survey of Fort Sandeman (p. 83).

12. Punjab, Punjab States and Delhi.

Air surveys in Multān district (p. 41).

Topographical surveys in Rāwalpindi district (p. 37); and in Multān, Muzaffargarh, Jhang and Lyallpur districts (p. 56).

Cantonment and City surveys at Amritsar, Lahore and Multān (p. 83).

Riverain surveys in Lyallpur, Montgomery & Shekhūpura districts (p. 56).

Boundary surveys in Dera Ghāzi Khān district & Bahāwalpur State (p. 57).

Framework in Lyallpur and Montgomery districts (p. 56); in Gurdāspur and Kāngra districts (p. 56). Rectangulation in Multān, Muzaffargarh, Jhang and Lyallpur districts, (p. 56).

Levelling, one line of geodetic levelling Amritsar-Wazīrābād (p. 15); seven lines of secondary levelling and a large amount of tertiary levelling for the Haveli Project (p. 85).

Miscellaneous, Upper Bāri Doāb Canal survey in Gurdāspur and Kāngra districts (p. 56, 57).

13. Rājputāna Agency, Ajmer and Bīkaner. *Nil.*

14. Central India Agency and Gwalior.

Topographical surveys in Bundelkhand Agency, Nowgong and the States of Orchhā, Pannā, Chhatarpur, Charkhāri, Bijāwar, Alīpura Garrauli and Tori-Fatehpur; Bihat, Naigawān Rebai, Dhurwai and Bijnā Jāgīrs (p. 59).

15. United Provinces.

Topographical surveys in Jhānsi and Hamīrpur districts (p. 59).

Forest surveys in Bāndā and Jhānsi Forest Divisions (p. 60).

Cantonment and City surveys, traversing of Benares City Municipal area (pp. 52, 53).

Levelling, three lines of geodetic work, *i.e.*, Muttra-Cawnpore, Cawnpore-Benares and Dehra Dūn-Mussoorie and one of secondary work (p. 15).

16. Central Provinces.

Topographical surveys in Surgujā State and the Bālāghāt Bhandāra, Chānda, Nāgpur, Wardhā and Damoh districts (pp. 52, 54, 62).

Framework in Jashpur and Surgujā States (p. 53). Bālāghāt, Bhandāra, and Drug districts (p. 55).

17. Bombay Presidency, States of W. India and Baroda.

Topographical surveys in Hyderābād and Karāchi districts of Sind (p. 40).

Forest surveys in west Nasik Division (p. 66).

Cantonment and City surveys of Karāchi and environs (p. 39).

Framework, triangulation and traverse for topographical surveys in Hyderābād and Karāchi districts of Sind (p. 40). Rectangulation and traversing in Lārkāna and Nawābshāh districts of Sind (p. 47).

Levelling, four lines of geodetic work *i.e.*, Surat-Dhūlia, Porbandar-Rājkot, Tatta-Mughalbhin and Hyderābād-Sukkur (p. 15).

18. Hyderābad.

Topographical surveys in Adilābād, Karimnagar, Aurungābād, Secunderābād and Bolārum (p. 62); in Raichūr district (p. 64).

Miscellaneous, large-scale surveys of the Ellora and Ajanta Caves (p. 62).

19. Mysore and Coorg.

Topographical surveys in Tumkūr and Chitaldrug districts (p. 64). Mysore district (p. 66).

Framework, triangulation in the neighbourhood of Hoskote near Bangalore for the Royal Artillery (p. 64).

Miscellaneous, large-scale surveys of private tea and coffee estates in Kadūr district (p. 64).

20. Madras Presidency and Madras States.

Topographical surveys in Anantapur, Bellary and Kurnool districts and Sandūr State (p. 64); in Coimbatore, Nilgiri, Salem and Trichinopoly districts (p. 66).

Miscellaneous, large-scale surveys of private estates in the Coimbatore district (p. 66); in the Kottayam and Devikolam districts of Travancore State (p. 66).

21. Bihar and Orissa.

Topographical surveys in Hazāribāgh, Palāmau, Rānchī, Mānbhūm, Santāl Parganas and Singhbhūm districts; in Keonjhar and Mayūrbhanj States (pp. 52, 70, 71, 72).

Forest surveys, Palāmau and Chaibāsa Forest Divisions (p. 52), State forests of Mayūrbhanj (p. 72).

Framework in Hazāribāgh, Palāmau, Mānbhūm, Rānchī, Balasore and Cuttack districts; in Keonjhar, Mayūrbhanj and Nilgiri States (pp. 52, 53, 70, 72).

Levelling in Mānbhūm district (p. 71).

22. Bengal Presidency and Sikkim.

Air survey in Chittagong district for Settlement surveys (pp. 41-43).

Topographical surveys in Bānkurā, Burdwān, and Midnapore districts (pp. 70, 72).

City surveys in Calcutta City (p. 73).

Framework in Bānkurā, Jalpaigurī and Rangpur districts and Cooch Behār State (p. 70).

Levelling, six lines of secondary levelling for the Calcutta Port Trust and Bengal Government (p. 84). Minor levelling in the Bānkurā district (p. 71).

23. Assam and Bhutān.

Topographical surveys in Goālpāra, Kāmrūp, Khāsi and Jaintiā Hills and Gāro Hills districts (p. 73).

Forest surveys in Goālpāra, Kāmrūp and Gāro Hills Forest Divisions (p. 74).

Framework in Goālpāra and Gāro Hills districts (p. 73).

24. Burma, Andamans and Nicobars.

Topographical surveys in Bassein and Myaungmya districts (p. 75); Salween, Thatón and Toungoo districts (p. 78).

Forest surveys in Delta Forest Division (pp. 75, 76); Thaton and Salween Forest Divisions (p. 78); Magwe, Meiktila, Prome, Yamethin and Mu Forest Divisions (pp. 80, 81).

Cantonment and City surveys of Maymyo and environs (p. 79).

Framework, Principal triangulation from the Burma Coast Series southwards to a point 20 miles south-west of Rangoon. Minor traverse by topograhical parties in Bassein, Hanthawaddy Ma-ubin, Myaungmya and Pyapon districts (p. 76); triangulation and traverse in Insein, Pegu and Thaton districts (p. 79).

Levelling, two lines of secondary levelling for the Burma Government (p. 85).

25. Transfrontier.

Topographical surveys of Nepāl (p. 92).

II.—ABSTRACT OF GEODETIC OPERATIONS.

DIRECTOR:—{ Lt.-Colonel M. O'C. Tandy, D.S.O., O.B.E., R.E., up to 30-6-27.
Dr. J. de Graaff Hunter, Sc.D., M.A., F.Inst.P., from 1-7-27.

26. General.—Besides geodetic work, the Director, Geodetic Branch administers the following offices at Dehra Dūn; *No. 2 Drawing Office*, the *Forest and Cantonment Office* and the *Publication and Stores Office*, whose work is reported in the annual Map Publication and Office-work Report; also the following Survey operations which are reported in other parts of this General Report:—*Commercial levelling* (*i.e.* levelling carried out in aid of special engineering projects and paid for by those concerned, *vide* para. 33 below); *Cantonment Surveys* (para. 201); *Training School* (para. 208). In addition the Director has been charged with the general administration of the *Nepāl Survey* during the past three years (Appendix II), with the *Bhopāl Detachment* from 1st December, 1925 to 31st March 1927, and with the *Shaksgam Expedition* (para. 209).

27. Geodetic.—Purely geodetic operations include miscellaneous computations and research, preparation and publication of records, observatory work (astronomical, magnetic, seismological and meteorological); important series of triangulation, geodetic levelling, precise latitudes, longitudes, azimuths, and gravity determinations, in all parts of India; and prediction of the Tides at 38 Eastern ports between Suez and Singapore.

These geodetic operations are fully described in the Annual Geodetic Reports of the Survey of India. The full reports have fallen into arrears since 1922, during the changes in the system of annual reports (*vide* Appendix I), but there is now at press a combined Geodetic Report for the years 1922-25, and separate Reports for the year 1925-26 and for the current year 1926-27. The following is a brief abstract of the geodetic operations described in the Geodetic Report for the current year, which includes complete Index maps and detailed results.

Geodetic Operations for 1926-27.

28. Observatory Section.—*International Longitude*—The most important geodetic operation of the year has been the determination of the basic longitude of India, as part of an international project in which 40 of the leading observatories of the world took part. The project was put forward in 1924 by General Ferrié, President of the

International Longitude Commission, for the simultaneous determination of longitudes by means of radio time-signals. This project was developed and finally given effect to, in October and November, 1926. From 1924 onwards preparations were made at Dehra Dūn for the work. These included the building of a small observatory, and the purchase of a clock of the highest precision, which had to be installed in a special room in which the temperature is automatically maintained constant. A radio receiving set, capable of picking up long-wave time-signals, was obtained, and other additions were made to existing equipment. These preparations were made by Dr. J. de Graaff Hunter, who also had charge of the final operations. At various observatories, the relative differences of local time of the receipt of the world time-signals, attained with the highest possible precision give the relative longitudes. For the attainment of this precision two transit instruments and one prismatic astrolabe were employed. Observations extending from 9 P.M. to 3 A.M. were made on nearly all nights from 1st October to 30th November. The time signals sent out by Bordeaux and Saigon were received both by day and by night. In this arduous programme six observers took part: Captain G. H. Osmaston, M.C., R.E., Captain G. Bomford, R.E., Lieut. H. W. Wright, R.E., Lieut. I. M. Cadell, R.E., Mr. B. L. Gulatee, B.A., and Mr. R. B. Mathur, B.A.

The final value of the longitude will be derived when all available observations of the various participating observatories have been considered as a whole. The provisional result already obtained shows the longitude of Dehra Dūn to be 0·02 seconds of time more easterly than the value obtained in 1894-96 by Colonel Sir Sidney Burrard, K.C.S.I., R.E., F.R.S., and Colonel Sir Gerald Lenox-Conyngham, Kt., R.E., F.R.S., by the older method of wire telegraphy.* It is anticipated that the recently determined value will not be changed by more than one hundredth of a second when the final reduction is complete. The evidence, so far as

*This telegraphic determination took these officers two years to accomplish (1894—1896) as longitude differences had to be separately measured between Greenwich, Potsdam, Tehrān, Būshire, Jāsk and Karāchi, and line-clear was necessary on the public telegraphic lines at pre-arranged times on several nights for each section, while extreme patience and accuracy were required to secure good results. Wireless methods have now enabled us to get an international determination of greater certainty at a comparatively trifling cost, but it is very satisfactory to the Department, and must be a source of gratification to the two officers concerned, to find the results of their labours of over 30 years ago confirmed within about one-fiftieth of a second in time, which corresponds with an actual difference of less than 10 yards in the relative positions of Greenwich and India.

it goes, indicates that during the last 30 years there has been no measurable change in the longitude of India of the type involved in Professor Wegener's hypothesis.

Magnetic and meteorological observations were taken as usual at Dehra Dūn throughout the year. Several magnetic storms were recorded, those occurring on 14th to 16th October 1926, and 14th to 16th April 1927 being of very great intensity. The second of these coincided with the earthquake in Japan on 16th April 1927. The Omori Seismograph recorded 25 earthquakes during the year, of which 2 were major and 23 minor. The Haig Observatory is being rebuilt and will be used as a regular latitude observatory. When it is completed, the Tide Predicting Machine and the Omori Seismograph will be installed in it.

Miscellaneous.—The periodical comparisons against the Standard Bar I, of tapes used by the high precision spirit-levelling detachments of No. 17 Party are now made by the Observatory Section. The base-line comparator is used for this work. A growing interest in the working of the scientific instruments of the Dehra Office has been evident from the greater number of visitors to the observatories during the year.

29. Computing Section.—At the request of Professor Wegener, the results of latitude observations at stations in India, occupied at long intervals of time, up to 70 years, were scrutinized. Our conclusion is that no appreciable movements of the earth's crust have occurred in India since 1800, either northwards or southwards. Graphical adjustment of topographical triangulation on a large scale was done for the Director, Frontier Circle. Numerous computations for star charts, astrolable reductions in connection with the International Wireless Longitude operations, aneroid heights for Sir Aurel Stein's work in the Pāmirs, and remodelling of professional forms were carried out. 50 degree-sheet triangulation pamphlets (including some of the Mesopotamia triangulation) were compiled or recompiled.

Part III, Auxiliary Tables, which is in course of reprinting, has been further supplemented by star charts on the stereographic projection, for latitudes 30° and 15°. The Geodetic Report covering a period of 3 years 1922-25, the first volume of a new series of publications, and also the second volume 1925-26, have been edited.

30. Tidal Section.—Since 1921 India has taken over tidal predictions for 38 ports between Suez and Singapore. This has led to a considerable economy. Certain modifications in prediction have been introduced and mechanical additions have been made to the tide-predict-

ing machine, whereby the predicted times of high and low water are registered electrically on a separate sheet. The curves representing the height of water at any time can accordingly be run off on a much reduced time-scale, which is a practical convenience.

Tidal registrations were carried out by means of self-registering tide-gauges at Aden, Basrah, Bombay, Karāchi, Madras, Kidderpore, Rangoon, Bassein and Deserter's Creek (Rangoon River).

In addition to the above, the readings of the actual times and heights of high and low water, taken on tide-poles during daylight only, were continued at Bhāvnagar, Chittagong and Akyab under the orders of the Port Officers concerned, who forwarded the results monthly. Weekly charts of the tidal curves registered on the automatic tide recorder at Ma'qil continued to be received from Basrah for each month. The observations for the year 1924 at Bassein have been reduced by the method of harmonic analysis.

The printing and publication of the 1928 Tide Tables for Indian ports is expected to be completed by about the end of October, 1927. Advance printed copies of the Tide Tables for 17 ports for 1928 were despatched to the Hydrographer to the Admiralty by the end of March, 1927.

During the year the tidal obervatories at Bassein and Rangoon were inspected. A new tide-gauge was installed at Deserter's Creek (Elephant Point. Rangoon River) and tidal registrations were started from the 20th March, 1927.

31. Gravity and Deflections.—(Nos. 13 and 14 Parties)—No field work was undertaken, but the Hayford reductions of the stations observed at in Kashmir in 1925 were carried out. The personnel were occupied with the longitude work referred to in para. 28 above, and with other researches, including levelling across wide rivers (*vide* para. 32).

32. High Precision levelling.—(No. 17 Party)—The work reported in this paragraph is levelling of the highest possible accuracy. It forms part of the second geodetic level net of India, which was commenced in 1920. As projected it consisted of 13,300 miles of levelling, to which 908 miles have since been added. 4,800 miles have now been completed. During 1926-1927, 1,271 miles of single levelling were carried out as below, which are equivalent to 524 miles of completed work.

In fore direction only.—

Bombay.—Tatta to Mughalbhin, 66 miles.

Punjab.—Amritsar to Wazirābād, 105 miles.

In back direction only.—

Bombay.—Dhūlia to Surat, 152 miles.

United Provinces.—Muttra to Cawnpore, 237 miles.

United Provinces.—Cawnpore to Benares, 220 miles.

In both directions.—

States of Western India.—Porbandar to Rājkot, 268 miles.

Revision.—

(*h*) *Sind.*—Part of Hyderābād to Sukkur, 183 miles.

Refraction correction.—It has long been considered possible that lines of levelling along persistent slopes may have a systematic error due to refraction. The line from Dehra Dūn (2,200 feet) to Mussoorie (6,500 feet) was considered a rather extreme case, and an estimate was made in 1910 of the possible amount of error resulting from this cause. In the present year the line has been relevelled in both directions, and the necessary temperature readings have been taken to enable the refraction to be computed. The result found is that a correction of +0·03 feet should be applied to the height of Mussoorie above Dehra, which is about one third of that arrived at in 1910 using estimated temperatures.

This appears to show that a refraction correction is not ordinarily worth considering.

Levelling across rivers.—An enquiry into the most precise method of carrying spirit-levelled heights across wide rivers has been made. Field experiments were carried out and useful practical deductions have been made regarding the best method to employ and the precision that will be obtained thereby.

33. *Commercial levelling.*—Details of secondary and tertiary levelling for various engineering projects also carried out by No. 17 Party are given in Part X of this report, paras. 206, 207.

34. Miscellaneous.—*Organization and Offices.*—In 1922 the Tidal Party was abolished and its work handed over to the Computing Party, while a new charge—the Publication and Stores Office—was formed in its place. This latter office includes the Photo-Zinco Office, the Letter-press Printing Office and the workshops and stores, and thus relieves geodetic officers of extraneous distractions, while providing for the closer supervision of these miscellaneous duties and enabling us to cope with the increased work due to our having taken over from England the responsibility for Tidal Piredictions and the preparation of Tide Tables in 1922. As a result steady improve-

ments in efficiency and organization have become possible, and Lt.-Colonel M. O'C. Tandy, D.S.O., O.B.E., R.E., has brought these improvements to a head during his year and a half as director with very satisfactory results in all directions. Clerical and accounts duties have been re-distributed so as to clear up the previous confusion of responsibilities; the two map stores have been amalgamated and brought under the same roof with the Forest and Cantonment Office, and the building, hitherto used as a transit observatory and for helio-photography, has been altered to accommodate the training school, while the old steam engine which worked the printing presses is being replaced by an electric plant. The library and records have been brought into the main building with the Computing Office and a most interesting *Museum* of old geodetic instruments and records has been established near the library to illustrate various branches of the work as carried out during the past 100 years; this was opened to the public in March 1927, and has attracted many visitors. Meanwhile Dr. de Graaff Hunter, being relieved of petty distractions, has been able to effect marked improvements in observatory arrangements, especially in regard to Time observations and Tidal Predictions.

III.—ABSTRACT OF MAP PUBLICATION AND OFFICE WORK.

35. Full Reports of the work of all drawing, printing, and miscellaneous offices of the department, with *Index Maps* showing the progress and present state of map publication on various scales, have been published separately in the *Map Publication and Office Work Report* for the financial year ending 31st March 1927. The following extracts from the full Report show the most important result of all this work, in the shape of Publications and Issues, etc.

Table I *(a)*—Maps published at Calcutta, during the year 1926-27.

Class of maps.	Scale.	New publications.	Reprints and new editions.	Number of sheets printed.	Value. Rs.
GENERAL MAPS.		*Departmental.*			
Maps of India	Various	1	3	14,690	19,835
GEOGRAPHICAL SERIES.					
Southern Asia	1:2,000,000	2	3	1,850	6,407
India and Adjacent Countries	1:1,000,000	5	44	23,550	43,344
Carte Internationale du Monde	1:1,000,000	3	4	2,550	7,650
TOPOGRAPHICAL SERIES.					
One-eighth inch, (Modern) ...	1″=8 miles	5	...	1,650	2,425
Quarter-inch, (Modern) ...	1″=4 miles	31	16	18,950	29,381
Do. (Prely.) ...	1″=4 miles	9	2	5,090	7,672
Do. (Provl.) ...	1″=4 miles	...	41	11,650	17,268
Half-inch, (Modern) ...	1″=2 miles	56	8	26,600	79,679
Do. (Prely.) ...	1″=2 miles	1	...	300	900
One-inch, (Modern) ...	1″=1 mile	142	106	123,333	188,999
Do. (Prely.) ...	1″=1 mile	18	3	7,600	11,387
Do. (Provl.) ...	1″=1 mile	...	1	200	300
Old style sheets	Various	...	28	6,675	10,318
SPECIAL MAPS.					
District maps	1″=4 miles	...	...	...	...
Administration report maps ...	1″=8 miles	...	...	...	...
Provincial maps	Various	3	6	4,220	14,928
Plans of Cities and Cantonments	Various	8	4	5,817	11,738
Index maps	Various	5	45	23,200	3,052
Miscellaneous maps ...	Various	27	16	20,390	13,449
Total ...	.....	**316**	**330**	**298,315**	**468,732**
		Extra-departmental.			
Maps	Various	140	46	159,574	35,094
Plans and diagrams ...	Various	326	6	258,888	18,430
Illustrations	.....	102	...	49,064	8,922
Miscellaneous	.....	80	33	243,275	8,307
Total ...	.....	**648**	**85**	**710,301**	**70,753**
Grand Total ...	.....	**964**	**415**	**1,008,616**	**539,485**

Table I *(b)*—Maps published at Dehra Dūn.

Class of maps.	Scale.	New publications.	Reprints and new editions.	Number of sheets printed.	Value.
		Departmental.			*Rs. as. p.*
Cantonment maps ...	Various	67	101	12,510	25,020 0 0
Forest maps ...	,,	216	27	14,364	16,563 2 9
Miscellaneous ...	,,	4	2	2,204	495 14 0
Total ...	...	**287**	**130**	**29,078**	**42,079 0 9**
		Extra-departmental.			
Maps	Various	103	6	20,883	7,456 10 7
Plans & diagrams ...	,,	180	17	76,866	6,999 0 10
Charts	4″ = 1 mile	606	...	69,664	11,099 0 0
Total ...	...	**889**	**23**	**167,413**	**25,554 11 5**
Grand Total ...	...	**1,176**	**153**	**196,491**	**67,633 12 2**

Table II—Abstract of modern topographical maps.

	One-inch sheets.	Half-inch sheets.	Quarter-inch Degree sheets.
Topographical maps published in 1926-27	142	56	31
Do. do. published in previous years.	2,284	609	152
Total published ...	**2,426**	**665**	**183**
Number of sheets in India ...	**6,218**	**1,630**	**450**

Table III.—Letterpress publications.

(a) PUBLISHED AT CALCUTTA.

1. **General Report of the Survey of India for 1925-26.** (475 copies).
2. **Map Publication and Office Work Report 1924-25.** (475 copies).
3. **Map Publication and Office Work Report 1925-26.** (300 copies).
4. **Supplement to the General Report 1924-25.** (75 copies).
5. **Supplement to the General Report 1925-26.** (75 copies).
6. **Hand-book of Topography, Chapter V, (1926).** (600 copies).
7. **Corrections to the Hand-book of Topography, Conventional Signs, Type-Tables, &c., (50,000 copies).**
8. **Symbols and abbreviations.** (50 copies).
9. **Tacheometer Survey Note book.** (1.000 copies).
10. **List of maps published, issued monthly.** (800 copies).

Table III(*a*)—(*Contd.*).

11. List of F. O. U. O. maps, issued quarterly. (150 copies).
12. Survey Notes, issued monthly. (350 copies).
13. Government of India, Circular Orders, &c. (13,200 copies).
14. Distribution List of maps. (500 copies).
15. Distribution List of General Report. (50 copies).
16. Instructions for candidates for the Class II Service. (200 copies).
17. Instructions for candidates for the Upper Subordinate Service. (1,100 copies).
18. Annual Indents for European Stores. Various.
19. Calendar for 1927. (3,000 copies).

(b) In Hand at Calcutta on 1st April 1927.

1. *Hand-book of Topography, Chapter I, Revision of Appendix III.*
2. *Hand-book of Topography, Chapter VIII, Revised Edition.*
3. *Hand-book of Topography, Chapter XI, Revised Edition.*
4. *Corrections to the Hand-book of Topography.*
5. *Hand-book of Topography, Chapter IV, Addendum to—*
6. *Camp Officers' Record Book.*
7. *Index to names, Calcutta—Howrah guide map.*
8. *Photo.-Litho. Office Annual Indent of European Stores.*

(*c*) PUBLISHED AT DEHRA DŪN.

1. Records of the Survey of India. Volume XIX. The Magnetic Survey of India. (350 copies).
2. Records of the Survey of India. Volume XXI. (1) Air Survey in the Irrawaddy Delta.
   (2) Report of the Bhutān and South Tibet Survey Detachment. (400 copies).
3. Professional Paper No. 20: Reconnaissance Survey from Aircraft. (350 copies).
4. *The Tide*, forming Part V of the Hand-book of Trigonometrical Instructions. (310 copies).
5. Auxilliary Tables, Part I, Fifth Edition, reprinted. (300 copies).
6. Levelling Pamphlet No. 44, Revised and extended. (300 copies).
7. Levelling Pamphlet No. 46, Addendum. (300 copies).
8. Trianguiation Pamphlets (8). (100 copies of each).
9. Tide Tables, Indian Ports for 1927. (7,445 copies).
10. Theodolite Resection. (200 copies).
11. Reduction of Pendulum Observations—Addendum. (400 copies).
12. Traverse Tables. (500 copies).
13. Correction slips to Tide Tables. Auxiliary Tables, Levelling and Triangulation Pamphlets, &c. Various.
14. Lists of Bench-marks. (100 copies).
15. Circular Orders (Administrative) from January 1919 to December 1922. (450 copies).
16. Professional forms. (97,645 copies).
17. Miscellaneous jobs. (285,341 copies).
18. Calender for 1927. (500 copies).

Table III—*(Concld.).*

(d) In Hand at Dehra Dūn on 1st April 1927.

1. *Geodetic Report 1922—25.*
2. *Report on Irrigation Surveys.*
3. *Hand-book of Topographical Instructions, Chapter IV—Theodolite Traversing (Revised Edition).*
4. *Hand-book of Topographical Instructions, Chapter VII; Addendum to —*
5. *Levelling—Part VI of the Hand-book of Trigonometrical Instructions (Revised Edition).*
6. *Levelling Pamphlet 41 J—Addendum to—*
7. *Levelling Pamphlet 73, Addendum to —*
8. *Secondary levelling sheet No. 85 P.*
9. *Triangulation Pamphlets (10).*
10. *Tide Tables, Indian Ports for 1928.*
11. *List of Cantonment and Military Stations in India (2 parts).*
12. *List of vernacular terms used in Survey of India maps.*
13. *Government of India Orders from January 1919 to December 1924.*
14. *List of periodical returns.*
15. *Circular by Surveyor General on Air Survey.*

36. Notes.—*Calcutta.*—In addition to the work shown in Table I(*a*) material was supplied for fair sheets of the Eastern and Burma Circles, and for the compiled fair sheets of all Circles, and also for the new Catalogue of Maps (under preparation) and for numerous extra-departmental maps, Nine indexes, in colours, for the General and Map Publication Reports and Supplement, were printed.

The work of surprinting the minute mesh on stock copies for the Army Department, which during the year involved several thousand sheets, is nearing completion.

37. *Dehra Dūn.*—In addition to the work shown in Table I(*b*) above, 62,972 prints of 1,011 originals, consisting of plane-table sections, triangulation charts and pamphlets, and forest maps were printed.

38. *The offices* in regard to which full information is given in the Map Publication Report are:—The *Seven Drawing Offices* at the seven circle and branch headquarters; the *Photo.-Litho., Map Record and Issue,* and *Mathematical Instrument* Offices, Calcutta; the *Publication and Stores* and the *Forest and Cantonment* Offices, Dehra Dūn; and a few minor map printing establishments at other places.

39. Map Issues.—Table IV.—Maps issued by Survey units.

D=Departmental X=Extra-departmental.		On book transfer (to Government officials).		On cash payment.		Free issues.		TOTAL.	
		Number of copies.	Sale Value. Rs.	Number of copies.	Sale Value. Rs.	Number of copies.	Value. Rs.	Number of copies.	Sale Value. Rs.
Calcutta	D	87,790	91,307	101,463	1,06,943	59,879	94,654	249,132	1,98,250*
	X	702,173	63,790	26,142	17,028	3,538	840	731,853	80,818*
Dehra Dūn	D	14,517	24,306	2,132	5,956	6,808	12,520	23,457	30,262*
	X	75,916	12,297	46,466	9,097	66	115	122,448	21,394
Quetta ("E" Company)	X	.....	.....	1,407	909	.....	.....	1,407	909
Peshāwar (No. 18 Party)	X	...	.....	601	231	.....	.....	601	231
Mussoorie	D	.....	.....	290	474	.....	.....	290	474
Bangalore	D	151	287	2,882	5,601	.....	.....	3,033	5,888
Shillong	D	.....	.....	398	985	.....	.....	398	985
Maymyo	D	.....	.....	72	166	.....	.....	72	166
Totals	...	880,547	1,91,987	181,853	1,47,390	70,291	1,08,129	1,132,691	3,39,377

* These figures do not include the value of free issues.

40. *Map Record and Issue Office, Calcutta.*—Issues of departmental publications on book debit to Government Officials exceeded last year's figures by 26,443 copies; extra-departmental issues, on book debit, however, show a drop of 196,205 copies.

Cash sales and free issues of departmental publications increased by 37,594 and 39,328 copies respectively; extra-departmental cash sales fell by 42,840, while free issues showed a slight increase.

Steel almirahs with a total of 5,440 shelves (the figure 6,750 in last year's report was incorrect) have now been erected in the map store-rooms, at a total cost of Rs. 98,997.

These accomodate all the map sheets in modern style published up to date. Almirahs containing 5,860 shelves still remain to be constructed to provide storage for the complete Survey Programme.

41. *Dehra Dūn Map Office.*—The great bulk of the Issues from Dehra Dūn are Forest, Cantonment, and other special maps for other Government departments. During the year the separate Map Issue Offices of the Forest Map Office and No. 2 Drawing Office were amalgamated and brought under one roof.

42. Stock of Maps.—*Calcutta.* A comparison of Table I(*a*) with Table IV shows that whereas 1,008,616 sheets have been published at Calcutta during the year, only 986,786 sheets have been issued; therefore stocks in hand have increased by 21,830 sheets (316 new maps). The total stocks in hand in Calcutta are estimated at 5,000,000 sheets.

Dehra Dūn. The corresponding figures for Dehra Dūn are 196,491 published, 145,905 sheets issued; stocks in hand have increased by 50,586 sheets (287 new maps). The total stocks in hand in Dehra Dūn are estimated at 319,000 sheets.

43. Mathematical Instrument Office.—The demands on the office for the supply and repair of instruments and the workshop outturn all show a considerable increase compared with recent years (*vide* 1, 2 and 6 in the following Table). Demands by Irrigation Departments and Railways were unusually high.

Up to 31st March 1927.	1924-25.	1925-26.	1926-27.
	Rs.	*Rs.*	Rs.
1. Total value of stores issued ..	3,75,024	4,20,340	**5,17,410**
2. Value of repairs carried out to order ...	1,28,931	1,34,008	**1,40,144**
3. Value of instruments, etc., returned to Store by those who no longer require them	51,875	51,045	**99,369**
4. *Book Value of Stock*			
(*a*) In Serviceable Store	3,25,685	2,55,474	**2,48,669**
(*b*) In Repairable Store	1,04,859	81,527	**80,559**
(*c*) In Material Store	2,35,449	2,16,136	**1,94,132**
5. *Value of New Instruments and Materials*			
(*a*) Manufactured in Workshops ...	1,42,616	1,75,874	**2,40,642**
(*b*) Purchased locally	35,356	43,326	**83,016**
(*c*) Imported through the Stores Department, London ...	95,750	92,003	**1,82,919**
6. *Workshops*			
(*a*) Value of work done	3,82,467	4,31,269	**4,71,518**
(*b*) Cost of employees (including pension contribution) ...	1,52,166	1,60,659	**1,70,980**
(*c*) Average number of employees ...	No. 386	No. 412	**No. 458**

IV.—ABSTRACT OF TOPOGRAPHICAL WORK.

44. The following Tables show the progress of the topographical programme assigned to the Department in 1905 and the out-turns and cost-rates of different parties during the year under report.

45. Progress. It was hoped in 1905 that maps on the scale of 1 inch to 1 mile would be available for the whole Indian Empire within 25 years; but the work has been greatly retrenched and delayed from various causes, and in 1913 the Secretary of State sanctioned a scheme for the reduction of the scale of survey in the less populous areas. Allowing for the surveys to be carried out on the reduced scales of ½ inch and ¼ inch to 1 mile, under this scheme, we may roughly regard half the work as being completed by 1925; though there is a tendency to revert to the 1-inch scale in special cases owing to the pressing requirements of geologists and engineers, combined with the modern military view that this is the smallest scale suitable for tactical operations. Table B gives an idea of the work ahead according to present policy, and the state of the work is shown in the *Index Map* at the end of this volume.

Revision of modern surveys has also become necessary in some important frontier tracts and is already much needed in some other areas. Also some areas surveyed on smaller scales have had to be resurveyed on a larger scale. The figures for this work are given in italics at the end of Table A.

Table A.—Progress of Topographical Surveys since 1905.

Scales of survey mostly 1 inch to 1 mile, but including a good deal of ½-inch work, and some ¼-inch occasionally.

Survey years.	Old Northern Circle.	Old Southern Circle.	Old Eastern Circle.	TOTALS.
	Sq. miles.	*Sq. miles.*	*Sq. miles.*	*Sq. miles.*
1905-10 ...	70,784	44.675	52,885	168,344
1910-15 ...	116,958	70.765	51,654	239,377
1915-20 ...	33,713	59,916	40,654	134,283
1920-25 ...	82,777	106,619	66,703	256,203
Totals to 1925 ...	**304,232**	**281,975**	**211,896**	**798,207**

Table A.—*Continued.*

The Burma Circle was separated from the Eastern Circle in 1922-23. The Northern and Southern Circles were reformed as three Circles in 1925-26. The above totals have therefore been redistributed amongst the present five Circles, as shown below:—

Survey years.	Frontier Circle.	Central Circle.	Southern Circle.	Eastern Circle.	Burma Circle.	TOTALS.
	Sq. miles.	*Sq. miles.*	*Sq. miles.*	*Sq. miles.*	*Sq. miles.*	*Sq. miles.*
Up to 1925 ...	172,382	213,774	200,051	89,587	122,309*	798,103
1925-26 ...	4,906	11,621	14,187	6,029	6,012	42,705
1926-27 ...	**7,964**	**6,036**	**13,753**	**10,889**	**5,543**	**44,185†**
Up to 1927...	**185,252**	**231,431**	**227,941**	**106,505**	**133,864**	**884,993†**
Balance remaining.	*346,363*	*206,569*	*115,609*	*178,730*	*132,011*	*979,282*
Total programme.	**531,615**	**438,000**	**343,550**	**285,235**	**265,875**	**1,864,275†**

Revision and Re-survey of the above work.

Up to 1926 ...	*2,717*	*284*	*Nil*	*70*	*344*	*3,415*
1926-27 ...	*1,286*	*Nil*	*1,007*	*Nil*	*672*	*2,965*

* These figures have been revised since last report.

† These totals are exclusive of the area surveyed in Nepāl on the 1-inch scale, 14,025 sq. miles were surveyed in 1926-27, bringing the total for the Nepāl Survey to 54,995 square miles.

Table B.—Analysis of balance remaining on 31st October 1927.

Proposed scale of survey.	Frontier Circle.	Central Circle.	Southern Circle.	Eastern Circle.	Burma Circle.	TOTALS.
	Sq. miles.	Sq. miles.	Sq. miles.	Sq. miles.	Sq. miles.	Sq. miles.
1½-inch & over	47,669	...	...	...	...	47,669
1-inch ...	61,778	51,172	115,609	128,285	110,473	467,317
½-inch ...	205,427	148,739	...	50,445	21,538	426,149
¼-inch ...	31,489	6,658	...	...	...	38,147
Totals.	**346,363**	**206,569**	**115,609**	**178,730**	**132,011**	**979,282**

Table C.—Areas and Cost rates of Surveys, 1926-27.

Party and Locality. Character of country.	Scale and description of work.		Area in sq. miles of each description of work.	Cost rate per sq. mile (including computation and mapping).	Total area of Topographical Survey.	Total expenditure October 1st 1926 to Septr. 30th 1927.	Overall cost rate of Topographical Survey.	Remarks.
"A" Company.—North-West Frontier Province.				Rs.	Sq. m.	Rs.	Rs.	**FRONTIER CIRCLE.**
Medium & high hills partly wooded	One-inch	Triangulation	3,301	4·3				
Ditto ditto	... One-inch	Original survey ...	2,301	11·9				
Ditto ditto	... One-inch	Original survey ...	728	.....				
Bare medium hills ...	... 1½-inch	Original survey ...	81	157·1				
Medium hills, thickly wooded	... Four-inch	Original survey ...	20	193·8	**4,382**	1,81,989	**41·5**	728 sq. miles surveyed in recess 1927.
Bare hills ...	... Two-inch	Revision ...	85	6·7				
Bare hills and cultivated plains	... 1½-inch	Revision ...	691	10·8				
Punjab—								
Undulating country ...	... 1·13333	Resurvey ...	93	212·9				
Ditto ...	... 1½-inch	Revision ...	403	10·8				
"E" Company.—Sind *(Karāchi and Hyderābād districts)* and **Baluchistan** *(Las Bela and Kalāt States).*								
Bare rocky hills ...	... 1½-inch	Triangulation	35	41·9				
Open desert plain ...	... One-inch	Triangulation	1,870	9·3				(a) Excluding the following :—
Irrigated plain with jungle	... 1½-inch	Traverse	270	15·2				Rs.
As above, and desert ...	... 1½-inch	Original survey ...	811	29·9				Drawing and Reproduction Section ... 12,497
	1½-inch	Resurvey ...	1,618					Purchase of Quetta Office ... 52,908
	Half-inch	Resurvey ...	1,076	16·0				Miscellaneous special jobs ... 1,528
	One-inch	Resurvey ...	3	30·6(a)				66,933
Very difficult rugged hills	... One-inch	Original survey ...	260					
Karāchi—								
City Area and Environs	... Four-inch and Three-inch	Resurvey ...	101	219·8	**3,869**	204,989 (a)	**52·9**	The cost rates in column 5 also exclude the above amounts and also Rs. 62,799 the cost of training officers.
No. 23 Party.—Punjab—*Haveli Irrigation Project.*								
Cultivated plains and desert country with scrub jungle.	**Four-inch**	Special survey ...	585	77	**585**	45,046	**77**	

Table C.—Areas and Cost rates of Surveys, 1926-27.

Party and Locality. Character of country.	Scale and description of work.	Area in sq. miles of each description of work.	Cost rate per sq. mile (including computations and mapping).	Total area of Topographical Survey.	Total expenditure October 1st 1926 to Septr. 30th 1927.	Overall cost rate of Topographical Survey.	Remarks.
No. 1 Party.—Bihar.			Rs.	Sq. m.	Rs.	Rs.	**CENTRAL CIRCLE.**
Jungle-covered hills, open plateaus	One-inch **Triangulation** ...	2,186	6·5				
Low hills and narrow valleys mostly covered with thick jungle.	One-inch Original survey ...	693	25·0	1,746		78·0	(a) Excluding Rs. 15,500 for Benares City Traverse.
Do. do.	**Two-inch** Original survey ...	1,053	32·1		(a) 1,36,225		
Benares City area.—							
Congested narrow lanes	... 16- and 64-inch **Traverse** ...	5,120 Areas or 8 sq. miles.	3·6 per acre.				
No. 5 Party.—Central Provinces.							
Heavily wooded hills, partly cultivated and undulating.	One-inch **Triangulation** ...	2,220	6·6				
Undulating low hills, heavily wooded for greater part.	**One-inch** Original survey ...	2,165	23·75	3,066	58,951	19·22	
	One-inch Supplementary survey	901	8·58				
No. 22 Party.—Punjab.							
Rāvi riverain tract, level plain, fairly open.	24-inch Cadastral survey **Traverse**	250	4,32·3				
Indus and Panjnad riverain tracts, level plain, mostly wooded.	Punjab-Bhawalpur boundary demarcation **Traverse** ...	37 (linear miles).	15·5 (per linear mile).		1,14,367*		*Excludes:— (i) Muttra Nazul land Survey (additional debit) & fairmapping Rs. 632. (ii) Beas Reservoir Survey (additional debit) Rs. 391. (iii) Fairmapping of Lahore Town Survey (additional debit) Rs. 795. (iv) Fairmapping of Punjab U. P., boundary demarcation Rs. 689.
Upper Bāri Doāb Canal headworks and Chakki Khad diversion works, submountainous country.	**Eight-inch** survey, including traversing, planetabling, without mapping	14	4,08·4				
Jhansi Survey Detachment.—U. P. & C. I.							
Open cultivated plain & hillocks ...	One-inch Supplementary **Triangulation**	538	3·2		1,929		
Undulating wooded plains and occasional low well wooded hills.	**One-inch** Original survey	1,078					
	One-inch Resurvey ...	1,892	27·2	2,970	80,710	27·8	

Table C.—Areas and Cost rates of Surveys, 1926-27.

Party and Locality. Character of country.	Scale and description of work.	Area in sq. miles of each description of work.	Cost rate per sq. mile (including computations and mapping).	Total area of Topographical Survey.	Total expenditure October 1st 1926 to Septr. 30th 1927.	Overall cost rate of Topographical Survey.	Remarks.
No. 6 Party.—Hyderabad State & Central Provinces.			Rs.	Sq. m.	Rs.	Rs.	**SOUTHERN CIRCLE.**
Flat cultivated plains and intricate jungle covered hills.	One-inch Original survey ...	3,452	16·3 (a)	*			(a) This has been arrived at by having the cost of survey and dividing between scales viz., 1½-inch and ⅝-inch mapping both scales having been drawn in the party in the same recess season.
	One-inch Revision survey ...	1,007	7·3 (a)				
Interiors of caves and hills	... 250 ft. to 1 inch Special survey ...	2			(d)		
A typical Indian cantonment	... Three-inch Revision survey ...	45	9·5 (b)	5,130	1,29,122	25·2	
Chiefly flat country covered with thick forest.	One-inch Original survey ...	387	(a) 16·3				(b) Cost of survey only, no mapping of this has been done in this party.
Do. do. do.	One-inch Revision survey ...	239	(a) 7·3				
¾-inch mapping of same areas	... ...	4,489	(a) 12·0				(c) This includes mapping only which being recoverable from Hyderabad Govt. should be credited to surveys on 1½ & ⅝ inch scales.
2-inch mapping forest areas	... ...	555	(c) 7·9				
No. 7 Party.—Madras, Hyderabad and Mysore.							(d) Excludes Rs. 6,745 on account of survey of coal mines and special Guide Map of Ellora and Ajanta.
Open, undulating with isolated hillocks; rocky and jungle-clad hills.	One-inch Original survey ...	4,059	23·4	4,970*	84,058	17	
	Do.	260	1·5				
	Do.	502	2·9				
	Do.	149	0·9				
Steep and heavily wooded hills	... Sixteen-inch Original survey ...	6·5	759	4,933	759		* This includes about 85 square miles surveyed in parts of 57 A 3, 4 & 7.
No. 8 Party.— Madras Presidency and States.							(a) Includes 1", 4" and 16" original and revision.
Wooded hills	... ... One-inch Revision survey ...	1,490†	(f)				(b) Includes cost of triangulation, computation and fairmapping.
Plains. Madras Presidency hills	One-inch Original survey ...	2,976	20·6				(c) Includes cost of computation.
Do. and Mysore State do.		192			(a)	(b)	(d) Includes cost of taking and leaving the field.
Bombay Presidency.				4,728	157,725	33	(f) Worked on the Total cost 95,856 and area 4,658.
Forest-clad hills	... ... Four-inch Original survey ...	47	208·5				† Includes 69 sq. miles surveyed on 4" scale for the Cauvery (Matur) Project by No. 7 Party in 1925-26.
Madras Presidency and Madras States.		13	(d) 1,371				
Wooded and open slopes	... Sixteen-inch Original survey ...	10					
Madras Presidency and Madras States.	16-inch **Triangulation**	64	66·9 (e)				
Madras Presidency and Madras States.	One-inch **Triangulation**	4,382	(e) 3·7				

Table C.—Areas and Cost rates of Surveys, 1926-27.

Party and Locality. Character of country.	Scale and description of work.	Area in sq. miles of each description of work.	Cost rate per sq. mile (including computations and mapping).	Total area of Topographical Survey.	Total expenditure October 1st 1926 to Septr. 30th 1927.	Overall cost rate of Topographical Survey.	Remarks.
No. 4 Party.—Chotā Nāgpur and Bengal.			Rs.	Sq. m.	Rs.	Rs.	EASTERN CIRCLE.
Open Plateau and densely wooded hills and valleys.	One-inch Triangulation ...	3,900	5·2				
Undulating ground, partly open and partly jungle-clad.	One-inch Supplementary survey	3,076	32·7	3,076	1,21,438	39·4	
Flat jungle-clad country with patches of cultivation.	Levelling for one-inch survey ...	54 (Linear miles).	7·3				
No. 9 Party.—Orissa and Bengal.							
Undulating wooded hills; mainly Sāl forest.	One-inch Triangulation ...	1,296	6·9				
Open flat plains partly wooded.	One-inch Traverse ...	1,120	10·4				
Undulating wooded hills, and open plains with wooded patches.	One-inch Original survey ...	1,867	33·3	3,323	1,23,872	37·2	
Low hills and open undulating plains with wooded patches.	One-inch Supplementary survey	1,439	26·1				
Calcutta city area	Six-inch revision survey ...	17	72·7				
No. 12 Party.—Assam and Bengal.							
Plains, partly open, but mostly covered with high grass, Sāl and Simul jungle.	One-inch Original survey ...	1,816	57·1				
	One-inch Triangulation ...	1,210	4·6				
	One-inch Traverse ...	680 (Linear miles).	27·8 per (Linear mile).	2,752	1,49,300	54·2	
Gāro Hills and Khāsi Hills.							
Densely wooded hills ...	Half-inch Original survey ...	936	36·4				
	Half-inch Triangulation ...	1,811	5·2				

Table C.—Areas and Cost rates of Surveys, 1926-27.

Party and Locality. Character of country.	Scale and description of work.	Area in sq. miles of each description of work.	Cost rate per sq. mile (including computation and mapping).	Total area of Topographical Survey.	Total expenditure October 1st 1926 to Septr. 30th 1927.	Overall cost rate of Topographical Survey.	Remarks.
No. 10 Party.—Lower Burma.			Rs.	Sq. m.	Rs.	Rs. per sq. M.	**BURMA CIRCLE.**
Level open cultivated country	One-inch **Traverse**	999 (Linear miles).	38·9 (per linear mile).				
Low wooded hills and cultivation	**One-inch** Original survey	1,358	54·8				
Mostly open cultivation; also low wooded hills and Delta forest.	**One-inch** Supplementary survey	1,060	43·6				
Jungle-clad hills	**One-inch** Revision survey	580	31·1				
Low undulating forest-clad hills	**Two-inch** Original survey	62	124·2	**3,060**	1,89,854 *(a)*	**62**	*(a)* Includes Rs. 7,707 debitable to the Forest Department, Burma.
No. 11 Party.—Lower Burma.							
Jungle-clad hills and undulating country mostly jungle-clad.	One-inch **Triangulation**	2,120	9·6				
	One-inch **Traverse**	92 (Linear miles).	44·8 (per linear mile).				
High hills densely wooded	**One-inch** Original survey	2,359	61·0				
Undulating and wooded	**One-inch** Supplementary survey	209	37·6				
High hills densely wooded	**One-inch** Revision survey	35					*(b)* Excludes cost of mapping.
Low wooded hills	**Four-inch** Original survey	2	313·0				
Maymyo Guide Map	**Four-inch** Revision & re-survey	41	141·6 *(b)*	**2,646**	1,95,696 *(c)*	**74**	*(c)* Includes Rs. 506 debitable to the Forest Department, Burma.
No. 21 Party.—Upper Burma.—*Reserved forests.*							
Steep rugged hills densely wooded	Four-inch **Traverse**	542 (Linear miles).	122·7 (per linear mile).				
High densely wooded hills	**Two-inch** Original survey	411	167·2				
Wooded hills and undulating country.	**Four-inch** Original survey	82	361·9				
Densely wooded hills	**Four-inch** re-survey	16		**509**	1,79,765 *(d)*	**353**	*(d)* The whole cost is debitable to the Forest Department, Burma.

Table D.—Average monthly out-turns, 1926-27.

All out-turns are given for surveyors (excluding pupils and men under training) for a month of 24 Working days.

Party.	Locality.	PLANETABLING.											TRIANGULATION.			TRAVERSING.				MISCELLANEOUS.			Remarks.
		½-INCH.		1-INCH.		1½-INCH.		2 INCH.	4 INCH.														
		Original or re-survey.	Supplementary or revision survey.	Original or re-survey.	Supplementary or revision survey.	Original or re-survey.	Supplementary or revision survey.	Revision survey.	Original survey.	3-inch survey.	4-inch survey.		For ½-inch survey.	For 1-inch survey.	For 1½-inch survey.	Main Circuits.	For 1-inch survey.	For 1½-inch survey.					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
			Square miles.							Acres.			Sq. miles.			Linear miles.							**FRONTIER CIRCLE.**
"A" Company.	Peshāwar, Hazāra, Attock & Rāwalpindi Dists.	...	...	45	...	28	48	138	...	...	...	...	...	350	...	...	...	...	...	...	...	...	
"E" Company.	Karāchi Dist. & Las Bela State.	51	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Kalāt State ...	...	...	34	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Karāchi & Hyderābād dists.	...	...	...	...	24	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Karāchi & Environs.	...	..	...	...	...	...	...	...	14	2	...	...	...	...	...	...	...	...	...	...	...	4-inch in congested area, 3-inch in environs.
	Sibi dist. & Kalāt State.	...	...	...	...	...	...	...	...	...	...	...	...	444	...	...	...	...	...	...	...	...	
	Hyderābād dist.	...	...	...	...	...	...	...	...	...	...	...	...	...	34	...	...	...	...	...	...	...	
	Karāchi & Hyderābād dists.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	45	...	...	...	...	
No. 23 Party.	Punjab ...	...	...	...	...	...	...	...	23	...	...	...	...	...	...	...	...	...	...	...	...	...	

Table D.—Average monthly out-turns, 1926-27.

All out-turns are given for surveyors (excluding pupils and men under training) for a month of 24 Working days.

Party.	Locality.	PLANETABLING.											TRIANGULATION.			TRAVERSING.				MISCELLANEOUS.			Remarks.
		½-INCH.		1-INCH.		1½-INCH.		2 INCH.	4 INCH.	8 INCH.													
		Original or re-survey.	Supplementary or revision survey.	Original or re-survey.	Supplementary or revision survey.	Original or re-survey.	Supplementary or revision survey.	Original survey.	Original survey.	Original survey.			For ½-inch survey.	For 1-inch survey.		For 8-inch survey of U. B. D. Canal.	For reverain survey.	For 64 and 16-inch survey.	For Punjab Bahawalpur boundary demarcation.				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
			Sq.	miles.						Acres.			Sq.	miles.		Linear		miles.					CENTRAL CIRCLE.
No. 1.	Bihār and Orissa and Central Provinces and Benares City.	...	...	24	...	...	...	9	...	...	...	...	...	232	...	...	...	1	...	...	...	...	
No. 5.	Central Provinces.	...	...	32	69	...	...	...	...	...	...	...	...	192	...	...	...	...	...	...	...	...	
No. 22 Punjab.	Rāvi riverain tract.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	29	...	...	...	...	...	
	Indus & Panjnad riverain tracts.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	27*	...	...	...	* Does not include laying down stones & offset work.
	Upper Bāri Doāb Canal area.	...	...	...	...	...	...	...	...	S.M. 2	...	...	...	...	...	23	...	...	...	...	...	...	
Jhānsi Survey Detachment.	United Provinces & Central India.	...	...	30	...	...	...	...	...	...	...	...	...	404	...	...	...	...	...	...	...	...	

Table D.—Average monthly out-turns, 1926-27.

All out-turns are given for surveyors (excluding pupils and men under training) for a month of 24 Working days.

Party.	Locality.	PLANETABLING.											TRIANGULATION.			TRAVERSING.				MISCELLANEOUS.			Remarks.
		½-inch.		1-inch.		1½-inch.		2 inch.	4 inch.	3 inch.	1 inch.	16 inch.											
		Original or re-survey.	Supplementary or revision survey.	Original survey.	Revision survey.	Original or re-survey.	Supplementary or revision survey.	Original survey.	Original survey.	Revision survey.	Original and Instructional survey.	Original survey.	For ½-inch survey.	For 1-inch survey.	For 16-inch survey.	Main Circuits.	For 1-inch survey.	For 16-inch survey.					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
			Sq.	miles.						Sq.	miles.		Sq.	miles.		Linear		miles.					SOUTHERN CIRCLE.
No. 6	Central Provinces.	...	...	387	239	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Hyderābād ...	...	...	3452	1007	...	...	...	...	45	...	...	...	...	...	...	...		...	...	...	...	
											Acres.												
No. 7	Madras and Hyderābād, Mysore and Sandūr States.	...	...	47	...	...	...	...	...	...	26	362	...	...	...	...	...	...	...	...	...	...	
											Acres.												
No. 8	Bombay and Madras and Mysore and Madras States.	...	...	35	60	...	...	...	1060	...	...	366	...	411	10	...	81	10	...	...	...	...	

Table D.—Average monthly out-turns, 1926-27.

All out-turns are given for surveyors (excluding pupils and men under training) for a month of 24 Working days.

Party.	Locality.	PLANETABLING.											TRIANGULATION.			TRAVERSING.				MISCELLANEOUS.			Remarks.
		½-INCH.		1-INCH.		1¼-INCH.		2 INCH.	4 INCH.											LEVELLING.			
		Original or re-survey.	Supplementary or revision survey.	Original or re-survey.	Supplementary or revision survey.	Original or re-survey.	Supplementary or revision survey.	Original survey.	Original survey.				For ½-inch survey.	For 1-inch survey.		Main Circuits.	For 1-inch survey.			For 1-inch survey.			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
			Sq. miles.							Acres.			Sq. miles.			Linear miles.				Linear miles.			**EASTERN CIRCLE.**
No. 4	Chotā Nāgpur	...	...	...	...	...	...	...	...	...	...	...	...	340	...	...	...	...	...	...	...	...	
	Chotā Nāgpur and Bengal.	...	...	...	35	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	Bengal ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	45	...	...	
No. 9	Orissa ...	...	...	...	...	...	...	...	...	...	...	...	...	220	...	...	66	...	...	...	...	...	
	Orissa and Bengal.	...	...	23	25	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
No. 12	Assam and Bengal.	53	...	24	...	...	...	...	...	...	...	...	523	478	...	...	39	...	...	...	...	...	

Table D.—Average monthly out-turns, 1926-27.

All out-turns are given for surveyors (excluding pupils and men under training) for a month of 24 Working days.

Party.	Locality.	PLANETABLING.											TRIANGULATION.			TRAVERSING.				MISCELLANEOUS.			Remarks.
		½-INCH.		1-INCH.		1½-INCH.		2 INCH.	4 INCH.														
		Original or re-survey.	Supplementary or revision survey.	Original or re-survey.	Supplementary or revision survey.	Original or re-survey.	Supplementary or revision survey.	Original survey.	Original survey.				For ½-inch survey.	For 1-inch survey.		Main Circuits.	For 1-inch survey.	For 4-inch survey.					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
			Sq.	miles.						Acres.			Sq.	miles.		Linear		miles.					**BURMA CIRCLE.**
No. 10	Lower Burma	...	...	27	39	...	...	8	...	...	...	...	...	...	...	...	57	...	...	...	...	...	(*a*) Maymyo Town Guide Map. Original and Supplementary Survey.
No. 11	Lower Burma	...	...	25	36	...	...		4(*a*)	...	...	...	...	240	...	...	15	...	...	...	...	...	
No. 21 (Burma Forest).	Burma Reserved Forests.	...	...	...	...	...	...	7	3	...	...	...	...	...	...	...	...	19	...	...	...	...	

V.—SURVEY REPORTS, FRONTIER CIRCLE.

DIRECTOR:— Lieut.-Colonel R. H. Thomas, D.S.O., R.E., to 18-11-26.
Colonel C. P. Gunter, O.B.E., R.E., from 19-11-26 to 26-12-26 and from 27-4-27.
Lieut.-Colonel R. H. Phillimore, D.S.O., R.E., from 27-12-26 to 26-4-27.

46. Summary.—The units administered by the Frontier Circle were "*A*" and "*E*" Survey Companies, Nos. 18, 23 and 24 Parties Settlement Survey Detachment and No. 6 Drawing Office. No. 24 Party was formed from 1st October 1926 for the Rectangular Survey of the Lloyd Barrage area for the Bombay Government.

47. *Training.*—4 Class I (R.E.) probationers, 7 Class II probationers, 18 pupil surveyors, 8 pupil draftsmen and 19 soldier surveyors commenced or continued their training in field and recess work in "*A*" and "*E*" Companies and No. 6 Drawing Office during the year. Of the Class I probationers, 2 were confirmed and transferred elsewhere, one proceeded on sick leave and one remained in the Circle. The 6 Upper Subordinate probationers under training last year were confirmed and posted to units and other Circles. One of the 18 pupil surveyors was discharged as unlikely to become efficient. One of the soldier surveyors under second period of training and also one under first period of training were reverted to their regiments. Two soldier surveyors under first period of training were transferred to another Circle.

Special.—Information for insertion in the proposed Indian Supplement of the War Office *Manual of Map Reading and Field Sketching* was compiled during the year and headway was made in the collection of information for the new Field Service Manual (Surveys), now under preparation.

48. *The field work* of units was as follows:—

"*A*" *Survey Company.* Topography on 1-inch, 1½-inch and 2-inch scales in sheets 43 B, C & G, 38 N & O; resurvey of Rāwalpindi and Environs on 1/13,333 scale and forest survey in sheets 43 B & F on 4-inch scale. Survey Exercise with the Royal Artillery.

"*E*" *Survey Company.* Topography on ½-inch, 1-inch and 1½-inch scales in sheets 35 O & P; 40 C & D; re-survey 3-inch and 4-inch scales of Karāchi and Environs including Manora and Kiamāri. Triangulation and traversing in advance.

No. 18 Party. Air Survey in Waziristān on 1½-inch scale; air survey of Multān and Environs on 3-inch scale. Compilation from rectified mosaics, supplied by Air Survey Company Ltd., of some villages in Chittagong district for Settlement Department, Bengal. Survey Exercise with the Royal Artillery.

No. 23 Party. Topography on 4-inch scale and traversing and demarcation of rectangles for the Punjab Irrigation Department in the area commanded by the Haveli Irrigation Project in sheets 39 M, N & O and 44 A & B.

No. 24 Party. Traversing and demarcation of rectangles for the Bombay Government in the area commanded by the Lloyd Barrage Project in Sind.

Settlement Survey Detachment. Traversing, triangulation and boundary survey in district Peshāwar for the Settlement Department.

"A" Survey Company.

Officer Commanding.—Capt. W. J. Norman, M.C., R.E.

49. General.—The field headquarters are at Rāwalpindi where mobilization stores for a survey section are kept, and Recess headquarters at Murree.

Survey of tribal territory, previously closed to the surveyor, was continued, and the survey of Buner and Swāt, commenced last year, was completed. Some modern sheets of 1905—10 were revised; and considerable areas were triangulated in advance for next season.

50. *Average strength* during field season was 3 Class I officers, 4 Class II officers, 2 Upper Subordinate officers and 50 Lower Subordinate officers.

Personnel.—Lt. Angwin was transferred to No. 6 Drawing Office in April 1927; Lt. Cadell joined in December; Mr. Alexander (Class II) was lent to No. 24 Party from February till April; Lts. Burn and Wilson joined in July for instruction. Three surveyors were discharged as unlikely to become efficient and two soldier surveyors have been reverted to their regiments; fourteen men were transferred to other Circles and units, and five were received.

51. Field work was organised as follows:—

Camp (1).—Lt. J. B. P. Angwin, R.E., with 7 surveyors surveyed

772 sq. miles on the scale of 1½ inches = 1 mile in Hassan Khel country and the Peshāwar district (sheet 38 O).

Camp (2).—Mr. A. A. Graham (Class II) assisted by Mr. Laltan Khan for part of the season, and surveyors A. S. Siddiqi and Torabaz Khan had charge of the training of one R.E. officer, 7 unclassified surveyors, 6 soldier surveyors and 4 pupil surveyors, and carried out revision survey in the Rāwalpindi district, including the large-scale map of Rāwalpindi and environs (scale 1/13,333).

Camp (3).—Mr. Laltan Khan, C.H., I.D.S.M., (U.S.S.), with 2 surveyors, completed 20 sq. miles of forest survey on the four-inch scale in the Hazāra Division (sheet 43 B/14, 43 F/2, 3).

Mr. Mohammad Hussain Khan, K.S., (U.S.S.), with 11 surveyors surveyed 783 square miles on the one-inch scale in Buner and Swāt (sheet 43 B).

Triangulation.—Mr. T. M. C. Alexander (Class II) triangulated 20 sq. miles in Hazāra district for forest surveys (sheet 43 B/13, 43 F/2 & 3).

Drawing Section.—Mr. F. W. Smith (Class II) with 7 Lower Subordinates carried on fair drawing in Rāwalpindi throughout the field season.

Summer Season.—Field work was also carried out during the summer of 1927 as follows:—

Mr. Afraz Gul Khan, K.S., C.H., (U.S.S.) triangulated 90 sq. miles in sheets 43 F and G in advance for next year's survey.

Mr. Mohammad Hussain Khan, K.S. (U.S.S.) with 6 surveyors carried out orginal survey on the one-inch scale of 783 square miles in sheets 43 B/1, 5, 6, 9, 10.

52. Areas surveyed.—A total of 2,071 sq. miles was surveyed comprising:—

783 sq. miles of original survey on the scale 1 inch = 1 mile in Buner and Swāt in sheet 43 B; and 81 sq. miles on the scale of 1½ inches = 1 mile in Hassan Khel, Afridi country in sheet 38 O; 20 sq. miles of original forest survey on the four-inch scale in Hazāra in sheets 43 B and F; 1,094 sq. miles of resurvey and revision survey on the scale of 1½ inches = 1 mile in Peshāwar District, N. W. F. P. and Rāwalpindi District, Punjab; 93 sq. miles of resurvey on the scale of 1/13,333 of Rāwalpidi and environs.

53. Recess duties.—Fair mapping was organised in two sections under Messrs Graham and Smith. Owing to various unavoidable delays

and to a summer field season in 1926, large arrears of fair-mapping had accumulated, but these are now being steadily reduced and 15 sheets were submitted for publication.

Sheet 38 H/11 was received from 18 Party with air survey compilation and was fair drawn and submitted. The air survey compilation for the Multān Guide Map was also received from 18 Party and the fair drawing is in hand.

The Rāwalpindi Guide Map was drawn as well as two maps of field-firing areas near Rāwalpindi on the six-inch scale for the local military authorities.

Mapping of the forest surveys in Hazāra district was postponed till next season.

54. Survey Exercise with Royal Artillery.—During October 1926 a Survey section was mobilized to carry out a tactical exercise with the Royal Artillery Survey Section, in order to test the possibilities of carrying forward a system of survey control during a rapid advance, and providing fixed points for the Royal Artillery and air-survey sections.

There was no directing staff for the exercise and no General Staff Officer was present. The principal lessons learnt were, that it is essential to practise co-operation between Survey units, the Royal Artillery and the Royal Air Force in peace, if work is to go smoothly during war, and that it is very desirable to hold an exercise as soon as possible in which all three take part. It was proved that in good weather and suitable country triangulation can keep up with a force advancing 8—10 miles a day; and that, if triangulation breaks down, a short base can be measured and the co-ordinates of points fixed in the area of a battle can be issued within 8 hours. The chief technical problems brought to light were: firstly, how to combine effectively the work of two observers working on the same triangulation, and secondly, how to expedite computations.

"E" Survey Company.

Officer Commanding :—Major E. O. Wheeler, M.C., R.E.

55. General.—The field headquarters were at Hyderābād (Sind), and Recess headquarters at Quetta.

The survey between Karāchi and Hyderābād adjacent to the N.W. Railway was continued and that of Karāchi and environs for the large-

scale Guide Map was completed. 130 square miles were traversed and 35 square miles triangulated for the current season's survey while 140 square miles were traversed in advance for the next season.

56. Average strength during the field season was 3 Class I officers, 10 Class II officers (7 on probation), 1 Upper Subordinate officer and 40 Lower Subordinate officers.

Personnel.—6 Class II probationers and 6 soldier surveyors joined for instruction. 6 U.S.S. officers were transferred to other units.

57. Field work was organised as follows :—

Camp (1).—Lt. D. R. Crowe, R.E., with 6 surveyors and 1 soldier surveyor surveyed 270 square miles on the scale of 1½ inches = 1 mile in sheet 35 P/9; 23 square miles on the four-inch scale and 78 square miles on the three-inch scale of Karāchi including the new Drigh Road Cantonment, Airship Base, Karāchi City and Cantonment, Kiamāri and Manora for the Guide map.

A new large-scale map of the major portion of Karāchi itself existed, on scales 20 feet, 40 feet, and 80 feet to the inch. During recess 1926 these large-scale sheets were reduced by hand to 800 feet = 1 inch and thence by photography to 4 inches = 1 mile and the survey of the congested areas was carried out on blue prints on this scale. In small portions, notably the Layāri Quarter, the large-scale map had not been published and survey was carried out *de novo*. In the outlying portions, including the Drigh Road area, three-inch enlargements of the previous season's two-inch topographical survey were made, and the new survey made on blue prints on this scale.

Camp (2).—Mr. A. J. A. Drake, D.C.M., (Class II), with 7 Class II probationers, 1 surveyor and 3 soldier surveyors surveyed 539 square miles on the scale 1½ inches=1 mile, and 807 square miles on half-inch scale in sheet 35 O, north and east of Karāchi.

Camp (3).—Mr. Imam Din (U. S. S.) with Lt. Wright, R.E., and 2 surveyors, 7 soldier surveyors and 1 traverser, surveyed 270 square miles on the scale of 1½ inches = 1 mile, re-surveyed 539 square miles on the same scale, and 269 square miles on the half-inch scale in sheets 35 O and 40 C.

Camp (4).—Mr. F. J. Griee, (Class II), with 7 surveyors and 1 traverser surveyed 541 square miles on the scale of 1½ inches = 1 mile (original survey) and resurveyed 270 square miles on the 1½-inch scale and 3 square miles on one-inch scale. They traversed an area of 140 square miles in advance in sheet 40 D/1.

Triangulation and Traversing.—Lt. H. W. Wright, R.E., triangulated 35 square miles in sheet 40 C for use in the current season. 130 sqr. miles were also traversed by camp 3 in this sheet. The triangulation was based on Rakhrāi H. S. and intersected point No. 4 of the Karāchi longitudinal G. T. Series, and the traversing on Rakhrāi and Jharrak (Jherruck) hill stations of the same series. Further traversing for next season's survey was carried out by Camp No. 4 as shown above.

Drawing and Reproduction Section.—Mr. Sadiq Ali (lent by the P. L. O.) with 11 men formed a permanent drawing and reproduction section at Quetta. The latter carried out many jobs for other departments, amongst which was the preparation of route plans showing the traffic arrangements for H. E. the Viceroy's visit to Quetta. Some reproduction work was also done for No. 24 (Sind Rectangulation) Party.

58. Areas surveyed.—Original survey of 811 square miles on the scale of 1½ inches = 1 mile; resurvey of 23 square miles on the scale of 4 inches = 1 mile; 78 square miles on the scale of 3 inches = 1 mile; 1,618 square miles on the scale of 1½ inches = 1 mile; 3 square miles on the 1-inch scale; and 1,076 square miles on the scale of ½ inch=1 mile; making a total area of 3,609 square miles of original survey and resurvey, on all scales. All this work lay in sheets 35 O and P and 40 C and D, in the Karāchi and Hyderābād districts of Sind and in the Indian State of Las Bela, in Baluchistān.

59. Recess duties.—During recess two fair mapping sections were organised, one in charge of Mr. F. J. Grice assisted by Mr. Najamuddin; and the other in charge of Mr. Imam Din assisted by Mr. Ghulam Hassan. The computing section was in charge of Mr. J. C. Berry.

The mapping of all field work was completed during the year, with the exception of the Karāchi Guide Map, a single one-inch and four half-inch sheets, which are now well in hand and will be completed by the permanent drawing section before 31st March 1928.

No. 18 (Air Survey) Party.

Officer in charge.— { Captain G. F. Heaney, R.E. to 15-5-27 and from 16-7-27.
" G. H. Osmaston, M.C., R.E. from 16-5-27 to 15-7-27.

60. *General.*—The functions of this party are fivefold:—

(*i*) Compilation of small-scale maps of inaccessible areas in unadministered territory. (*ii*) Experimental compilation of maps on medium and large scales in British India. (*iii*) Training personnel in air survey

work generally. (*iv*) Preparation of data, equipment for war, and organisation of the Air Survey Sections of No. 1 and No. 2 Survey Companies. (*v*) Map Reproduction and organisation of the Vandyke Reproducing section of No. 1 Survey Company.

During the year progress has been made in all the above.

It was hoped that the latest type of air-survey camera, the F(8), which had been on order some time, would be available for work during the field season, and the Multān survey was postponed in the hope of its arrival. Owing, however, to industrial troubles in England, which delayed production, the camera had not arrived in the country at the end of April. The want of the latest air-survey equipment and of pilots and photographers with special experience of air-survey work, has been keenly felt; until these are available it will be impossible to determine the value of air survey for medium and large-scale work.

The headquaters of the party are at Murree, the field headquarters at Peshāwar.

61. *Personnel.*—The strength of the party was 1 U. S. S. and 3 Surveyors excluding the reproduction section.

62. *Areas surveyed.*—110 square miles on 3-inch scale of Multān and surrounding country from photographs supplied by No. 27 Squadron R.A.F; 4 square miles on 16-inch scale for cadastral maps from photographs of Bengal by the Air Survey Company Ltd.; 40 square miles on 4-inch scale of Chittagong district from photographs by the same Company.

63. *Multān and surrounding district.*—The original 1-inch maps of Multān district are very out-of-date, and as work on irrigation projects, which will materially alter the face of the country, is now in progress, it was not considered advisable to revise the 1-inch maps. This 3-inch survey of Multān and surrounding country was undertaken to supply the need for an up-to-date map for military training purposes etc. The 3-inch scale was adopted, as it is the accepted scale for position maps, and is the largest scale on which the city and usual Brigade training area could be included, without making the map too large to print in one sheet.

Owing to the non-arrival of the F (8) camera the photography was carried out with the ordinary type of L.B. camera. A detachment of two D.H. 9.A machines from No. 27 Squadron R.A.F., Risalpur, proceeded to Multān for the work. All plates were developed and 1 print of each handed over to the Officer in charge, No. 18 Party, before the detachment left. The country was quite level and open and therefore suitable

for air survey. The camera used was fitted with an 8-inch lens and was flown at a height of about 9,600 feet above ground level giving a scale of about 4·4 inches to the mile.

A one-inch map was given to the R.A.F. on which the position of each "key strip" and "cross strip" required was marked. On receipt of a batch of prints the position of each was located and marked up on an index map on the 1-inch scale and the R.A.F. was informed exactly what ground they had covered and how any gaps were to be filled, etc. The prints were then fastened down by strips, on pieces of elastic, and a rough mosaic made by fitting these together and pasting down on to Bristol board. No attempt was made at control beyond obtaining the best fit between strips. This mosaic was then cut into pieces and given to surveyors to take out on the ground in order to fill in names and relative heights and to interpret any obscure detail.

Control was obtained as follows. Three "key strips" were prepared from photographs taken in an east and west direction across the top, middle and bottom of the area, the remainder of the area was then covered by a "cross strip" taken in a north and south direction. The photographs of "key strips" were each mounted separately on the left hand pages of an "album", made from an ordinary exercise book with slits cut in the pages to receive the photographs. These albums were then taken out on the ground and fixed points were identified in the area of each photograph; the particulars of each fixed point, which was only designated by a number on the photograph, were written on the opposite page. Rectangulation had just been carried out over nearly the whole area, so there was no difficulty in obtaining fixed points. When the corner stone of the rectangulation could not be identified in the photograph, some point appearing on it was chained to from adjoining rectangulation pillars and its position fixed by plotting by distances.

Compilation of the maps on the 3-inch scale was carried out in recess; on completion this will be made over to A Company for fair drawing.

64. *Survey in Chittagong District.*—This survey which covers an area of upwards of 1,500 square miles in sheets 79 M, N and O, and 84 A, B and C is being carried out for the Settlement Officer of Chittagong, to provide maps on a 4-inch scale of hitherto unmapped areas.

The country consists of flat cultivated and thickly-populated plains covered with paddy fields only a few feet above sea-level, interspersed with irregular ranges of hills rising to a couple of thousand feet. These hills are covered with such dense jungle that it is in places very difficult

to distinguish the courses of streams. A certain amount of errors are inevitable in the mapping of hilly country from vertical photographs but these have been reduced as far as possible by the resection method referred to below.

The photography was carried out by the Air Survey Company Ltd., at the end of the cold weather, and completed by the middle of April. The L.B. type of camera at present in use by the R.A.F. was used. The scale of photography is about 4 inches to the mile.

Rough mosaics were constructed by the company and sent to the Settlement Officer, Chittagong who marked on them the positions of points fixed by traverse. These mosaics were then forwarded to this party, together with plots of the traverse data on a 4-inch scale.

The instructions for mapping received from the Settlement Officer, Chittagong were "to show all roads, streams and the form lines of the hills, boundaries of cultivation and sufficient detail outside the margin of the forest, such as tanks, paths, village sites as would enable a man to identify his position on the forest boundary by reference to outside detail."

After one or two experiments the following procedure has been adopted:—

(*a*) Strips of photographs are plotted by the "Arundel" or resection method and the detail required is traced on to celluloid.

(*b*) These strips are then scaled by the use of photography and an enlarging lantern.

(*c*) The traverse data is traced from the plot on a sheet of celluloid and the scaled strips are traced on this, any small adjustments between the edges of strips being made.

(*d*) Overlapping photographs are now examined through a stereoscope and form lines are drawn on the prints. These prints are then placed under the celluloid, their positions adjusted by the outline and the form lines are traced.

(*e*) The map is transferred from the celluloid to a fair sheet.

Considerable difficulty and inaccuracy has been caused by the longitudinal overlap in many strips being too small. Where this overlap falls below 50% the resection method of plotting mentioned above cannot be carried out, and this method appears to be the only one which overcomes the inaccuracies arising from differences in the height of ground covered by a strip of photographs. With the excep-

tion of this defect the standard of photography has been extremely high and is incomparably better than that carried out by service machines, a special feature being the extreme clearness of the prints provided.

At the time of writing only forty square miles have been mapped, and the work has not yet progressed sufficiently to enable a true estimate of its accuracy or cost to be formed. These subjects will be dealt with in next year's report.

65. *Special surveys for experimental purposes.*—A cadastral map on the 16-inch scale of 4 square miles in Bengal Sheet No. 79 N was compiled from a rectified mosaic on the same scale from photographs taken by the Air Survey Company Ltd., this compilation was submitted to No. 1 Drawing Office, Calcutta for fair-mapping.

66. *Miscellaneous.*—A tactical exercise in which Captain G. F. Heaney, R.E., and two surveyors of this party took part was carried out in conjunction with the Artillery Survey Section in October 1926 in the vicinity of Abbottābād. For further details see the report by the Officer Commanding "A" Survey Company at p. 38.

67. *Reproduction.*—During the field season a small reproduction section was added to the party. It is equipped with a portable hand-press (Lieut. Chase's pattern), which can take plates up to 13″ by 18″, and with apparatus for preparing zinc plates by the Vandyke process. Various maps and diagrams were reproduced on payment for Military authorities, and the section was also of use in printing forms for departmental use. Details of work done will be found in the Map Publication Report.

It is hoped that the section will be enlarged so as to be capable of forming the Vandyke Reproducing Section of No. 1 Survey Company on mobilization.

68. *New Instruments received.*—One Stereoscope and counter plotter by Hilger was received during recess and will be reported on in next year's report.

No. 23 Party.

Officer in charge.—Mr. H. B. Simons.

69. *General.*—The party was employed on behalf of the Punjab Government in traversing, subdividing to 25 and 100 acre rectangles and surveying an area in sheets No. 39 M, N, O and 44 A and B commanded by the Haveli Irrigation Project.

The Traverse camp with headquarters at Khānewāl opened on the 1st of September 1926 to enable the traversing and a sufficient number of 2,400 acre rectangles, which form the basis of further subdivision, to be completed before the rest of the party took the field in November 1926. The Rectangulation camps were moved out as soon as main rectangles were ready for subdivision. The Topographical section was employed on the reduction of boundaries till the end of December when a sufficient area had been subdivided to provide work for the 10 surveyors.

The headquarters for the field was located at Multān and was moved to Karāchi for the recess.

70. *Personnel.*—The strength of the party was considerably increased owing to the large programme. The field strength of the party numbered six Class II officers, three Upper Subordinate Officers and 158 Lower Subordinate Officers (most of the latter being on the *purely temporary* list) and were distributed as under:—

Mr. O. N. Pushong (Class II) with 20 traversers and 10 computers traversed and computed in the field the whole area covered by the project and embedded the corner stones of the main 2,400 acre rectangles. Mr. Pushong having completed his programme by the middle of January 1927 was transferred with all his camp to No. 24 Party.

Mr. Jiya Lal Sahgal (Class II) assisted by Mr. J. P. Vastav (U. S. S.) and 35 rectangulators subdivided the southern half of the country to the east of the Chenāb River.

Mr. Abdul Karim (Class II) with 36 rectangulators subdivided into 25 and 100 acre rectangles the area to the west of the Chenāb River.

Mr. Duni Chand Puri (Class II) with 10 surveyors completed the topographical survey of a portion of the country on the west bank of the Chenāb River.

Mr. Mohammad Najamuddin (Class II) with Mr. Abdul Majid (U. S. S.) as assistant and 35 rectangulators subdivided to 25 and 100 acre rectangles the northern half of the area on the east bank of the Chenāb River.

Mr. Latif Khan (U. S. S.) with 5 draftsmen was employed throughout the field season on the reduction of boundaries from village *musāvis*.

71. *Area surveyed.*—A total area of 2,295·9 square miles was rectangulated of which 837·4 square miles was subdivided into 25 acre

blocks and the remainder, 1,458·5 square miles, into 100 acre blocks. 2,557·2 linear miles of traverse was run and 585 square miles of original survey completed on scale 4 inches = 1 mile.

The country comprises cultivated plains watered by inundation canals and desert country with scrub jungle which in parts was exceedingly heavy, necessitating a considerable amount of clearing.

72. *Traversing.*—The traverse covered the whole area and was controlled by connection, on the left bank, to intersected points of the Sutlej Series and G. T. Traverse Stations, and on the right bank to Māhiwāla T. S. of the Great Indus Series and certain minor stations of the Sind-Sāgar Series.

73. *Rectangulation.*—The positions of the corners of the main 2,400 acre rectangles were computed from the traverse and marked by stones embedded by the traverse camp. These 2,400 acre rectangles were later subdivided to 25 and 100 acre blocks, according to the requirements, by the rectangulation camps.

74. *Topographical surveys.*—Mr. Duni Chand Puri was in charge of the plane-tabling which was carried out on the scale of 4 inches = 1 mile.

75. *Recess duties.*—Mr. Duni Chand Puri was in charge of a drawing section of 12 draftsmen employed on completing the field sections, preparing the spot height and contour charts and reducing the boundaries of village *musāvis* for the next field season.

No. 24 Party.

Officer in charge.— Major H. E. Roome, M.C., R.E., from 1-10-26 to 19-5-27 and from 22-8-27.
Mr. O. N. Pushong, from 20-5-27 to 21-8-27.

76. *General.*—In 1926, the Bombay Government requested the Survey of India to submit proposals for carrying out a rectangular survey over the area of Sind commanded by the Lloyd Barrage Project. As a result, No. 24 Party was formed on 1st October 1926, to demarcate an area of approximately 12,000 square miles into rectangles of 64 acres in size, the whole project to be completed in 4 years. The field headquarters of the Party opened at Hyderābād (Sind) on 15th October 1926, and, on conclusion of the field work early in April the headquarters moved to Karāchi.

77. *Personnel.*—The field strength of the Party numbered 2 Class II officers, 1 Upper Subordinate Service Officer, and about 57 Lower

Subordinate Officers, most of whom are borne on the *purely temporary* establishment. Under Mr. O. N. Pushong (Class II), on completion of his work early in January 1927 in No. 23 Party on the Haveli Irrigation Project, were 19 traversers, while the balance of the traversers was under Mr. Amrit Ram (U. S. S.) assisted, for one month only, by Mr. T. M. C. Alexander (Class II).

78. *Area rectangulated.*—It was decided that the area of a main rectangle, on which further subdivision is based, should be 4 square miles. The co-ordinates of the corners of these rectangles were computed, and their positions on the ground determined by 3,688 linear miles of traversing and marked by stones. These corners were demarcated over an area of 3,590 square miles in the Lārkāna and Nawābshāh districts. The next operation, known as exterior rectangulation, consists in sub-dividing the exterior sides of these main rectangles and this was completed over an area of 1,294 square miles.

The work was controlled by connection to the intersected points and certain stations of the triangulation carried out in 1898 and following years. Many of these stations and practically all of the village trijunctions, which were traversed about the same time, have entirely disappeared, no measures for their maintenance having been adopted by the local authorities. The majority of the identified points were large tombs, which have been preserved by villagers from religious and sentimental motives, thereby forming excellent permanent marks.

The country dealt with is flat, and lies on either bank of the river Indus. A considerable portion of it is already cultivated under a system of inundation canals, while the remainder consists of desert areas containing scrub jungle and sand hills. Thickly wooded areas occur in the neighbourhood of the Indus, necessitating heavy cutting for line clearing.

79. *Miscellaneous.*—At conferences held at Karāchi in April 1927, it was decided to modify the original proposals and to restrict the scope of the present project to sub-rectangles of 320 acres in size, in order to economise the number of stones laid down, many of which, it is anticipated, will not be used for some years, when they may have disappeared.

A professional publication entitled "Report on Irrigation Surveys 1926" is in the press.

80. *Recess duties.*—Mr. Amrit Ram was in charge of the computing section of 9 men during recess, completing and binding the computations

of the field season; preparing maps and charts required by the Chief Engineer, Lloyd Barrage and Canals Construction, etc., and computing data in advance for next field season.

Settlement Survey Detachment.

Officer in charge.—Rai Sahib Maya Das Puri, (Class II).

81. *General.*—The detachment continued the work of traverse, triangulation, and boundary survey in continuation of last year's programme in district Peshāwar (*tahsīls* Peshāwar and Nowshera) in degree sheets 38 N and O, and 43 C for the Settlement Officer Peshāwar. The field headquarters were at Campbellpore and the detachment recessed at Murree.

82. *Personnel.*—The field strength of the detachment consisted of 3 Upper Subordinate officers, and 69 Lower Subordinates, distributed as follows:—

Mr. Muhammad Husain (U. S. S.), *Camp* (*1*), with 11 traversers.

Mr. Dalip Singh Gandhi (U. S. S.), *Camp* (*2*), 12 traversers.

First class Surveyor Muhammad Ayub Khan, *Camp* (*3*), 2 surveyors. This officer also carried out plane-tabling himself.

Mr. Mohabat Lal Kohli (U. S. S.), and 43 lower subordinates were employed on plotting, computations, area extraction, reduction of *musāvis*, etc.

Camps (*1*) and (*2*) traversed and triangulated in the Peshāwar *tahsīl*. *Camp* (*3*) carried out village boundary survey in the Nowshera hills.

At the close of field operations in April, due to reduction of the programme, Mr. Muhammad Husain was transferred to Geodetic Branch Dehra Dūn, 20 *purely temporary* men were discharged, 3 transferred to other units, and 11 sent on departmental leave.

83. *Triangulation and Traversing.*—422 square miles of the Peshāwar *tahsīl* and 4 square miles of Nowshera riverain area were traversed and triangulated, a narrow strip of 33 square miles along the Afridi border in the Peshāwar *tahsīl* was left till next season due to political reasons. Village boundaries were surveyed in 149 square miles of the Nowshera hills on the scale 12 inches=1 mile.

The hilly portions of the Peshāwar *tahsīl* covering an area of 83 square miles (sheet 38 O), were first supplemented with points fixed by minor triangulation and then traversed as usual. No heights were observed as they were not required by the settlement authorities. In 339

square miles of the flat area main circuits were run along main roads and sub-circuits along village boundaries and in the interior of villages, providing about 20 stations per square mile. In villages close to Peshāwar city points were fixed about two chains apart on account of the area being much closed in by gardens. The work was connected with 11 triangulated stations.

The Peshāwar *tahsīl* was generally flat, fertile and well irrigated. The southern and western areas were hilly and intersected by ravines. The Nowshera hills were barren with scattered patches of cultivation.

84. *Plotting, Computing, etc* :—

(*a*) *Reduction of musāvis.*—

Early in the season Mr. Mohabat Lal Kohli, and Munshi Ruldu Khan, second-class draftsman, with 4 others were employed on the reduction of 24-inch scale *musāvis* (*tahsīls* Chārsadda, Mardān, Swābi) by pentagraph to scale 4 inches = 1 mile for the use of the Settlement Officer, Peshāwar, and to scale $1\frac{1}{2}$ inch = 1 mile for the Officer Commanding, "A" Company for compiling the latest frontier boundary on one-inch sheets.

(*b*) *Area extraction.*—

During October and November 1926 first-class traverser Lorind Chand with 7 men extracted the areas of 30 villages in the Swābi *tahsīl* by planimeter and graphically.

(*c*) *Plotting.*—

In the middle of November the replotting of the Nowshera *tahsīl* on superior *musāvis* was taken up on the scale 24 inches to a mile at the special request of the Settlement Officer Peshāwar. The area comprised 702 square miles including 164 villages. Two sections—one under Mr. Mohabat Lal Kohli, and the other under Babu Lorind Chand—were formed with 11 draftsmen in each section. This work was completed by the end of January 1927.

On the completion of the Nowshera replotting the plotting of the Peshāwar *tahsīl* on 24 inch scale, an area of 422 square miles including 277 villages, was commenced by Mr. Mohabat Lal Kohli's section, and continued during the rest of the field season; the other section was disbanded.

(*d*) *Computations.*—

First-class computer Joti Sarup supervised the computations with the help of 16 computers and proved all the current season's work during the field season. Besides the normal work, the conversion of rectangular co-ordinates into spherical values of the permanent points was started.

85. *Miscellaneous.*—Duplicate traces for the Settlement Officer Peshāwar were made of four-inch Indus congregated maps from Attock bridge to the end of Peshāwar-Hazāra district boundary, showing river detail and boundaries as prepared during the last and present settlements; traces were prepared in duplicate of the four-inch reductions of the frontier boundary (*tahsīls* Chārsadda, Mardān, and Swābi) with compiled detail and village boundaries from the four-inch *patwāris'* indexes, and of the quarter-inch index maps of the Swābi, Nowshera and Peshāwar *tahsīls* showing assessment circles and necessary detail.

86. *Recess duties.*—During recess the 24-inch plotting and drawing of quarter-inch triangulation and traverse charts were done by Mr. Mohabat Lal Kohli with 9 draftsmen.

The area extraction of 34 villages, containing 80 square miles of the Swābi *tahsīl* was carried by Mr. Dalip Singh Gandhi with 7 computers.

The computation section consisting of 14 men was looked after by the Officer in charge with the help of two senior computers. The rectangular co-ordinates of all the *pakka* points laid out in the whole of the Peshāwar and Peshāwar districts during the last four seasons, number ing over 3,000 were converted into spherical values; the computation records of all the work done during the current season were completed.

Several villages of the Dera Ismail Khān district were compiled on the scale 4 inches = 1 mile and their areas extracted with a view to comparing the same with those worked out at the last settlement, in order to ascertain the standard of accuracy of the existing settlement maps and whether they were fit to be utilized in the coming settlement.

87. In September 1927 a surveyor was deputed to survey an area of 27,200 square yards on the scale of 1 inch=20 feet with contours at an interval of 5 feet, in Sanawar near Kasauli Hill, for the Garrison Engineer, Simla Hills. The Survey was done under the supervision of the Garrison Engineer and the total cost was met by him.

VI.—SURVEY REPORTS, CENTRAL CIRCLE.

DIRECTOR:—{Lt.-Col. R. H. Phillimore, D.S.O., R.E., to 20-12-26.
{ „ L. C. Thuillier, I.A., from 21-12-26.

88. Summary.—The units administered by the Central Circle were Nos. 1, 5 and 22 Parties, Jhānsi and Bhopāl Survey Detachments and No. 3 Drawing Office.

The Bhopāl Survey Detachment was transferred from the administrative control of the Director, Geodetic Branch to that of Director Central Circle on 1st April 1927.

The officer in charge of No. 5 Party in addition to his normal duties, continued to act as Assistant Director of Surveys, Central Provinces, and administered the revenue, town and other surveys of that Province.

89. *Training.*—At the commencement of the year 22 pupils and 2 soldier-surveyors were under training. Of these pupils 6 were promoted to the unclassified list and the remainder are making satisfactory progress. The two soldier-surveyors completed their first period of training in April and have been recommended for a second period of training.

Two soldier-surveyors under training were transferred to the Central Circle from the Frontier Circle in May 1927.

90. *The field work* of parties and detachment was as follows:—

No 1 Party.—Topography on the scales of 2 inches and 1 inch = 1 mile in sheets 64M and 73A. Traversing of Benares City for large-scale survey.

No. 5 Party.—Topography on scale 1 inch = 1 mile in sheet 55 P.

No. 22 Party.—Traverse and compilation of settlement *musāvis* in Lyallpur, Montgomery and Sekhūpura districts. Demarcation of a part of the boundary between Dera Ghāzi Khān district and Bahāwalpur State. Eight-inch survey of a portion of the Upper Bāri Doāb Canal area.

Jhānsi Survey Detachment.—Topography on scale 1 inch = 1 mile in sheets 54O and P.

No. 1 Party.

Officer in Charge.—Major R. Foster, I.A.

91. *General.*—The party was transferred from the United Provinces to take up special topographical survey on the scale of 2 inches = 1 mile for the Bihār and Orissa Government in Palāmau and Rānchi districts in sheets 64M and 73A. At the same time the sheets in which this area falls were surveyed to margin on the scale of 1 inch = 1 mile.

At the request of the United Provinces Government preliminary traverse of Benares City Municipal Area was carried out with a view to completing a detailed survey on a large scale of that City.

The field headquarters of the party were at Daltonganj, Palāmau district.

92. *Personnel.*—Two Class II officers were added to the strength of the party, two U. S. S. officers were transferred and one joined. Owing to the difficult nature of the country to be surveyed, 8 pupil surveyors were transferred and seven more qualified surveyors joined, and 6 traversers and 4 computers joined for Benares City work. Two surveyors were transferred to transfrontier work. The field strength of the party numbered 5 Class II officers, 1 Upper Subordinate Service officer and 44 Lower Subordinates, distributed as under:—

Mr. A. M. Talati, L.C.E. (Class II), *Camp (1)*, 10 surveyors.

Major C. H. Tresham, V.D. (Class II), *Camp (2)*, 11 surveyors, increased later to 14 surveyors.

Mr. H. T. Hughes, (Class II), *Camp (3)*, 9 surveyors.

Mr. R. N. Hastir, (U. S. S.), *Camp (4)*, Mr. S. R. Gupta, B.A. (Class II, under training), 6 traversers and 4 computers.

Mr. M. N. A. Hashmi, (Class II) and Surveyor Sardar Khan (L. S. S.) were employed on triangulation.

93. *Areas surveyed.*—An area of 1,053 square miles was surveyed on the scale of 2 inches = 1 mile in sheets 64 M and 73 A in Palāmau and Rānchī districts (Bihār and Orissa) including an area of 239·6 square miles of Government forest; an area of 693 square miles on the scale of 1 inch = 1 mile was surveyed in sheet No. 73 A, in Hazāribāgh, Palāmau and Rānchī districts and Surgujā State (C. P.). An area of 2,186 square miles was triangulated in advance in sheets 72 D and 73 A.

94. *Topographical surveys.*—

Camp (1) under Mr. A. M. Talati, L.C.E., surveyed 246·7 square miles on the scale of 2 inches = 1 mile in Palāmau district and 447·6 square miles on the scale 1 inch = 1 mile in Hazāribāgh, Palāmau and Rānchī districts.

Camp (2) under Major C. H. Tresham, V.D., surveyed 527·1 square miles on the scale of 2 inches = 1 mile and 181·4 square miles on the scale of 1 inch = 1 mile in Palāmau district.

Camp (3) under Mr. H. T. Hughes, surveyed 279·2 square miles on the scale of 2 inches = 1 mile in Palāmau and Rānchī districts and 64 square miles on the scale of 1 inch = 1 mile in Palāmau district and Surgujā State (C. P.).

The country in the area surveyed on the two-inch scale consists of irregular ranges of dense forest-clad hills, rising between 3,000 and 4,000 feet above sea level. Open spaces are small and scattered, and communications, other than a few fair roads, are only jungle paths. Along the boundary between Palāmau and Rānchī districts rise the ghats leading up to the Chotā Nāgpur plateau. These are steep and jungle-clad and impassable in many places. The work of the surveyors was considerably hampered by the presence of tigers, many of them man-eaters, which accounted for 12 of the local inhabitants during the period survey work was in progress. The country surveyed on the one-inch scale was less hilly and jungle-covered.

95. *Triangulation.*—Triangulation was carried out in the south-eastern half of 73 A and one sheet of 73 D, in Hazāribāgh, Palāmau and Rānchī districts and a small area of Jashpur and Surgujā States. Connection was made to the Calcutta Longitudinal Series.

96. *Special surveys.*—*Camp (4)* under Mr. R. N. Hastir completed the traverse of Benares City Municipal Area as a preliminary to taking up a detail survey of the City. 226 linear miles of traverse were carried out and 7,016 stations were fixed. The work was very difficult and arduous owing to the vast crowds, chiefly pilgrims, who blocked the streets and lanes. Traversers were compelled in certain localities to work at night. Traverses were run through every lane and principal bye-lane. Through the good work of the police, under the orders of the District Magistrate, and the tact of the officer in charge, the work was completed without any dispute or difficulty arising.

At the request of the Deputy Commissioner, Fyzābād (U. P.), Mr. H. T. Hughes demarcated a disputed boundary between 9 revenue plots in village Bareta in the Suburbs of Ajodhyā City.

97. *Recess duties.*—The fair mapping on the two-inch and one-and-a-half-inch scales of the field work was divided into three sections under Mr. A. M. Talati, Major C. H. Tresham and Mr. H. T. Hughes respectively and was all completed during the year.

The two-inch mapping was drawn for publication in black and brown only.

Mr. M. N. A. Hashmi and Surveyor Sardar Khan carried out the computation of their own triangulation.

Mr. R. N. Hastir was in charge of the computations of the Benares City traverse.

No. 5 Party.

Officer in Charge.—{Mr. P. A. T. Kenny, O.B.E., from 1-10-26 to 3-12-26 and from 21-3-27.
{Major J. D. Campbell, D.S.O., R.E., from 4-12-26 to 20-3-27.

98. *General.*—This party continued surveys on the scale of 1 inch = 1 mile in the Central Provinces in sheets 55 P and 64 C. The field

headquarters were again situated at Nāgpur in order to keep in touch with the Settlement Commissioner, Central Provinces, the officer in charge of the party being also Assistant Director of Surveys, Central Provinces.

99. *Personnel.*—The field strength of the party numbered 1 Class II, 3 Upper Subordinate Service officers and about 20 Lower Subordinates distributed as under:—

Mr. J. H. Johnson (Class II), *Camp (1)*, 10 surveyors.
Mr. Shadi Lal Dube (U. S. S.), *Camp (2)*, 3 surveyors and 3 pupils.
Mr. Nur Muhammad (U. S. S.), *Camp (3)*, 1 surveyor and 3 pupils.
Mr. J. R. Chibbar (U. S. S.) and traverser Raghubir Prasad (L. S. S.) were employed on triangulation.

100. *Areas surveyed.*—An area of 3,066 square miles was surveyed on the scale of 1 inch = 1 mile in 55 P in the Nāgpur, Chānda and Wardhā districts; of this 2,165 square miles was original and 901 square miles supplementary survey, the latter being government forest, for which 4 inches = 1 mile maps exist. An area of 2,220 square miles was triangulated in advance in 64 C for surveys in 1927-28.

101. *Topographical surveys.*—

Camp (1) under Mr. J. H. Johnson with headquarters at Chānda, surveyed 1,674 square miles on the scale of 1 inch = 1 mile in Chānda district.

Camp (2) under Mr. Shadi Lal Dube, with headquarters at Umrer, surveyed 834 square miles on the scale of 1 inch = 1 mile in the Nāgpur and Chānda districts.

Camp (3) under Mr. Nur Muhammad, with headquarters at Korā, surveyed 558 square miles on the scale of 1 inch = 1 mile in the Wardhā and Chānda districts.

The country surveyed, with the exception of a small open area in the north, is very heavily wooded, with large expanses of Government and *mālguzāri* forests, which necessitated the use of rope chains. Reductions of the 4 inch = 1 mile Forest Survey maps were found to be very accurate and only needed verification of detail on the ground. Forest boundaries were however in parts considerably affected by the creation of large reservoirs for irrigation canals, particularly in the case of the Asola Tank about 10 square miles in area. The climate on the whole was temperate, no extremes of cold or heat, except during the latter half of March, being experienced.

102. *Triangulation.*—An area of 2,220 square miles was triangulated by Mr. J. R. Chibbar and traverser Raghubir Prasad in 64 C in the Bālāghāt, Bhandāra and Drug districts and the Chuikhadān, Kawardhā, Khairāgarh and Nāndgaon Feudatory States. Progress was much delayed by dense forest, grass fires, haze and refractory menials and the triangulation was not completed till after the party had left for recess quarters.

103. *Recess duties.*—Mr. J. H. Johnson was placed in charge of the fair-mapping of the party, and was assisted by Mr. Shadi Lal Dube.

The services of Mr. F. B. Kitchen were later lent to the party by No. 3 Drawing Office to take over part of the fair mapping. Mr. Nur Muhammad, Mr. J. R. Chibbar and traverser Raghubir Prasad were responsible for the computations of the triangulation.

104. *Miscellaneous.*—Owing to the very unhealthy nature of the country, cultivable areas had decreased in many localities, but an effort is now being made by the Local Government to colonise it by the creation of large reservoirs.

No. 22 (Riverain) Party.

Officer in Charge.—Mr. Dhani Ram Verma, R.S.

105. *General.*—This party works chiefly for the Punjab Government but undertakes special surveys for other Government Departments and Municipalities who pay for the work. The party's programme for the year consisted in (i), traversing the riverain estates along the Rāvi river and laying down base-lines in sheets 44 B, E and F and plotting and compiling settlement *musāvis* for cadastral surveys by the Settlement Department of the Punjab Government; (ii), demarcation of a part of the Punjab-Bahāwalpur boundary, in dispute, lying in sheet 39 L, for the Punjab Government and Bahāwalpur Durbar; (iii), Upper Bāri Doāb Canal Survey on scale 8 inches = 1 mile in the Punjab and Kashmir State, in sheet 43 P, for the Irrigation Department of the Punjab Government.

The headquarters of the party remained at Lahore throughout the year as usual.

106. *Personnel.*—Owing to the curtailment of the riverain programme the strength of the party was considerably reduced. The party consisted of 2 Upper Subordinates and about 65 Lower Subordinate officers distributed as under :—

Mr. Jamna Prasad, R.S. (U. S. S.), *Camp (1)*, 12 traversers.

Babu Roda Ram (L. S. S.), *Camp (2)*, 13 traversers.

Babu Harnam Singh (L. S. S.), *Camp (3)*, 2 traversers and 4 surveyors.

Mr. Badlu Ram (U. S. S.) and Babu Jalaluddin (L. S. S.), with 16 computers and 15 draftsmen under them respectively, supervised the computing and plotting sections at headquarters.

During the year 2 traversers and 4 surveyors were transferred and 3 traversers were discharged.

107. *Areas surveyed.*—(*a*) 14·1 square miles of original survey were completed on scale 8 inches = 1 mile of the Upper Bāri Doāb Canal Head-works in Kashmīr State and Gurdāspur district and Chakki Khad Diversion Works in Gurdāspur and Kāngra districts in sheet 43 P.

(*b*). The area covered by minor traverse for riverain surveys in Lyallpur and Montgomery districts in sheets 44/B, E and F was 250 square miles.

(*c*). The area covered by main and minor traverses to form basis for the Upper Bāri Doāb Canal Survey on scale 8 inches = 1 mile in sheet 43 P was 15·6 square miles.

108. *Plotting Section.*—During the field season the plotting section under Babu Jalaluddin plotted traverse *chāndās* on *musāvis* and compiled boundary *musāvis* for cadastral surveys by the Settlement Department. The section also prepared four-inch compilation sheets of the riverain area traversed.

109. *Computing Section.*—During the field season the section under Mr. Badlu Ram was employed on traverse computations appertaining to the work of the season. The computations were done *pari passu* and the rectangular co-ordinates of the traverse stations were gradually supplied to the plotting section for plotting *musāvis*.

110. *Riverain surveys.*—*Camps* (*1*) *&* (*2*) carried out minor traversing of the riverain estates along the Rāvi river in Lyallpur and Montgomery districts for cadastral surveys by the Settlement Department. This was based on main circuits run in previous seasons. Village boundaries were traversed and the areas within them were covered with a traverse network to provide points to facilitate internal measurement by the *patwāri*.

The *kilābandi* boundaries of the villages brought under the *kilābandi* system in Montgomery district were specially surveyed by theodolite traverse, offsets by optical square.

Base-lines were laid out about 1 mile apart beyond the flood line on both sides of the Rāvi river in Lyallpur, Montgomery and Shekhūpura districts and demarcated with permanent mark-stones to serve as bases

for future survey and demarcation of boundaries and fields in the bed of the river.

24-inch *musāvis* of the *kilābandi* villages were reduced by pentagraph to the scale 4 inches = 1 mile for compilation of *kilābandi* boundaries.

All the traverse stations marked during the field season were plotted on four-inch sheets.

The country covered by traverse operations was for the most part densely wooded and involved heavy line-clearing. There was scarcity of labour in the Indus and Rāvi riverain tracts and much of this work had to be done by khalasis.

Plotted and boundary *musāvis* (settlement mapping sheets) of *kishtwār* and *kilābandi* villages on the scale of 1/2640 and traces of four-inch plot sheets were supplied to the Officer in charge, Remapping and Revision of Records of Rights of the Rāvi Riverain Area, Montgomery.

111. *Punjab-Bahāwalpur Boundary demarcation.*—*(by Camp 2).* This was undertaken for the Punjab Government and Bahāwalpur Durbār. It consisted of the demarcation of the boundary between *mauzās* Kacha Drigh (Dera Ghāzi Khān district) and Bet Wāghwar (Muzaffargarh district) on one side and *mauzās* Mehrān Samuka and Phorān (Bahāwalpur State) on the other side, at the junction of the Indus and Panjnad rivers in sheet 39 L.

For this purpose a theodolite and chain traverse was carried out, connecting with the base-lines laid out in the field season 1918-19.

In the course of demarcation 5 boundary marks were destroyed by a revenue official of Bahāwalpur State. They had to be relaid.

The length of the boundary demarcated was 7·5 linear miles. Boundary plots were prepared on *musāvis* on 24-inch scale and supplied to the Deputy Commissioner, Dera Ghāzi Khān.

112. *Upper Bāri Doāb Canal survey.*—This was undertaken for the Executive Engineer, Mādhopur Division, Upper Bāri Doāb Canal. It consisted of a plane-table survey on the eight-inch scale of the Rāvi river with the Canal Head-works in Gurdāspur district and Kashmīr State, of the Chakki Khad with its Diversion Works in Gurdāspur and Kāngra districts, and of a narrow strip of populated and cultivated country along their banks in sheet 43 P.

Main and minor traverses were carried out to provide points for the plane-tablers. The traverse was computed *pari passu* at the party head-quarters.

Connection was made with one principal station and one minor station of the North West Himālaya Series and with base-lines laid out in season 1915-16.

The provincial boundary lying in the bed of the Rāvi river and a district boundary on the Chakki Khad were compiled on scale 8 inches = 1 mile from the settlement *musāvis* of the area surveyed and incorporated in the plane-table sections.

Names and other information of Irrigation interest, supplied by the Executive Engineer, were typed on the original plane-table sections in office. The typed plane-table sections were sent in for reproduction in blue by photozincography. He was supplied with 8 sets of blue prints of the plane-table sections for annual revisionary survey and 2 sets coloured by hand for reference.

A synopsis of the rectangular co-ordinates of the Irrigation Survey pillars, which were specially surveyed by theodolite traverse, was supplied for future use.

The entire cost of the work was debited to the Irrigation Department.

113. *Recess duties.*—(*a*) The compiling and plotting section under Babu Jalaluddin compiled settlement *musāvis* in advance of the next season's work and prepared rough field traverse charts for the use of traversers in the next field season.

(*b*) The computing section, under Mr. Badlu Ram till the end of April, and subsequently under Mr. Jamna Prasad, R.S., completed all traverse computations of the year's work.

(*c*) The traverse chart section under Mr. Jamna Prasad, R.S., prepared manuscript traverse charts for degree sheets 38/O and P; 43/C, D, G, H and P, 52/D and 53/F.

(*d*) Babu Harnam Singh was in charge of the fair mapping of Muttra *Nazūl* Land survey on 64-inch scale and the Punjab—U.P. boundary survey on the scale of 4 inches = 1 mile of the last year. 2 large sheets of the former and 4 large sheets of the latter were fair drawn for reproduction by the Vandyke process. The other 4 sheets of the latter will remain incomplete, pending the completion of demarcation of two sections of the inter-provincial boundary falling in them, regarding which orders of the Local Government are awaited.

Jhānsi Survey Detachment.

Officer in Charge.— Mr. P. A. T. Kenny, O.B.E., from 7-12-26 to 16-3-27.
Mr. J. C. C. Lears, from 1-10-26 to 6-12-26, and from 17-3-27.

114. *General.*—This detachment was employed on 1 inch = 1 mile survey in sheets 54 O and P, in the United Provinces and Central India, with field headquarters at Nowgong, Central India.

115. *Personnel.*—The field strength of the detachment consisted of 2 Class II officers, 2 Upper Subordinate Service officers and 32 Lower Subordinate officers, distributed as under:—

Mr. J. C. C. Lears (Class II), *Camp (1)*, 9 surveyors.

Mr. O. D. Jackson (Class II), *Camp (2)*, 9 surveyors and 1 pupil.

Mr. Sajawal Khan (U. S. S.), *Camp (3A)*, 4 surveyors and 1 pupil.

Mr. Jagannath (U. S. S.), *Camp (3B)*, 6 surveyors and 2 pupils.

116. *Areas surveyed.*—The detachment surveyed a total area of 2,970 square miles on the scale of 1 inch = 1 mile, of which 1,078 square miles consisted of original survey in sheets 54 O and P, mainly in the Jhānsi and Hamīrpur districts of the United Provinces, in Nowgong in the Bundelkhand Agency and in the Orchhā, Charkhāri and Chhatarpur States of Central India. The remainder consisted of 1,892 square miles of resurvey in the north half of sheet 54 P, covering parts of the States of Orchhā, Bijāwar, Charkhāri and Chhatarpur of Central India.

A total area of 538 square miles of supplementary triangulation was executed in sheet 54 O.

117. *Topographical surveys.*—

Camp (1), under Mr. J. C. C. Lears, carried out original survey and resurvey in an area of 961 square miles in sheet 54 P. Mr. Sajawal Khan was in charge of this Camp at the beginning of the field season and Mr. Jagannath at the end, for short periods, during which Mr. Lears held charge of the detachment.

Camp (2), under Mr. O. D. Jackson, completed 1,081 square miles of resurvey in sheet 54 P.

Camp (3) was in charge of Mr. Jagannath when the field season commenced, but early in December this Camp was subdivided into two sections, *(3A)* and *(3B)*. Mr. Sajawal Khan was placed in charge of the former which surveyed an area of 359 square miles of original survey in 54 O, and Camp *(3B)* under Mr. Jagannath completed 569 square miles of original survey in sheets 54 O and P.

Of the 32 surveyors in the detachment 16 had been temporarily transferred to it for training. Three of the remaining surveyors were employed as instructors for 2 months at the beginning of the field season, and three others joined the detachment in the middle of January from No. 22 Party. These special circumstances account for the comparatively small out-turn for the season.

The triangulation data for the north half of 54 P was extracted from the chart of this degree sheet published in 1914. Difficulty was experienced here with all the intersected points, which were at variance

with their plotted positions. A reference to the computation volumes showed that the values of these points had apparently not been computed, and it is surmised that their spherical values on the chart had been obtained roughly only, from paper measurements.

118. *Triangulation.*—Triangulation for supplementary points was carried out in sheet 54 O by Mr. Jagannath, over an area of 538 square miles, covering parts of the districts of Jhānsi and Hamīrpur of the U. P.

119. *Special surveys.*—In the Bāndā and Jhānsi Forest Divisions of the Eastern Forest Circle, U. P., an area of 10 square miles of reserved forests was surveyed on the 1 inch = 1 mile scale during the season.

120. *Miscellaneous.*—A place of great public importance and archæological interest in the Chhatarpur State is the magnificient series of Brāhminical and Jain temples known as the Khajrāho temples, named after the ancient town of Khajrāho near which they stand. Their construction has been assigned to dates between the 9th and 11th centuries. Built of sandstone and gneiss, the carvings on some are exquisite and exceedingly rich and cover every inch of available space. The epigraphical records contained in them are of great historical interest. There is an annual religious fair held at the temples during March, which is attended by pilgrims from all parts of India.

121. *Recess duties.*—The fair-mapping of the field work was divided into two sections. Mr. O. D. Jackson, with Mr. Sajawal Khan to assist him, was placed in charge of one, and Mr. Jagannath, assisted by surveyor Ram Saran was responsible for the other. The mapping of all field work was completed during the year.

VII.—SURVEY REPORTS, SOUTHERN CIRCLE.

DIRECTOR:—Lt.-Col. C. M. Browne, C.M.G., D.S.O., R.E.

122. Summary.—The units administered by the Southern Circle during the year were Nos. 6, 7 and 8 Parties and No. 4 Drawing Office.

123. *Training.*—Twenty-one pupil surveyors were attached to No. 7 Party during the field season and 8 new pupils were entertained in recess 1927.

124. *The field work* of Parties was as follows:—

No. 6 Party.—Topography on the scale 1 inch = 1 mile in sheets 56 I, M, N and 47 M. Revision of the three-inch map of Secunderābād and Bolārum; guide maps of the Ellora and Ajanta Caves.

No. 7 Party.—Topography on the scale 1 inch = 1 mile in sheets 57 A, E and F. Sixteen-inch special surveys of estates in sheet 48 O.

No. 8 Party.—Topography on the scale 1 inch = 1 mile in sheet 58 E. Four-inch forest surveys in sheet 46 H and sixteen-inch surveys of estates in sheets 58 B and C.

No. 6 Party.

Officer in charge.—{ Major R. S. Wauchope, O.B.E., I.A., from 12-11-26.
Mr. E. A. Meyer to 11-11-26.

125. *General.*—The party carried out topographical surveys in the Central Provinces and Hyderābād State on the scale of 1 inch = 1 mile and also demarcated areas of mineral concessions. The Staff of the Secunderābād Area and the Poona District asked for certain special compilations of maps to be done, which required revision of half-inch work on the scale of ½ inch = 1 mile.

The field headquarters of the party were at Peddapalli till the 10th February 1927 when they had to be closed owing to scarcity of water, which was abnormal this year; they were reopened at Secunderābād from the 13th February 1927.

126. *Personnel.*—The field strength of the party numbered 3 Class II officers, 4 Upper Subordinate officers and 36 Lower Subordinate officers, distributed as under:—

Major R. S. Wauchope, O.B.E., I.A., *Camp (4)*, 5 surveyors.

Mr. E. A. Meyer (Class II), with assistance of Mr. Muhammad Abdul Azim, I.D.S.M. (U. S. S.), *Camp (1)*, 9 surveyors.

Mr. E. N. Natesan, B.A. (Class II), with assistance of Mr. J. A. Cabral (U. S. S), *Camp (2)*, 1 U. S. S. officer and 9 surveyors.

Mr. C. P. E. Davenport (Class II), *Camp (3)*, 9 surveyors.

127. *Areas surveyed.*—This party completed an area of 3,839 square miles of original and 239 square miles of revision survey on the scale of 1 inch = 1 mile in Chānda district of the Central Provinces (sheet 56 M) and the Adilābād and Karīmnagar districts of Hyderābād State (sheets 56 N and I). It also carried out 1,007 square miles of revision survey on the scale of 1 inch = 1 mile round Aurangābād (sheet 47 M) for the military authorities and 45 square miles of revision survey on the scale of 3 inches = 1 mile of the Secunderābād and Bolārum military map.

128. *Topographical surveys.—Camp (1)*, under Mr. E. A. Meyer, carried out 1 inch = 1 mile original survey in sheet 56 M/S.W. The adoption of this scale instead of the half-inch for the whole area is due to the fact that it contains large areas of forests which will eventually be produced for H. E. H. the Nizām's Forest Department on the scale of 2 inches = 1 mile. It has been found more satisfactory in such circumstances to survey the whole of the sheet on the larger scale than to have frequent changes of scale from one-inch to half-inch.

Camp (2), under Mr. E. N. Natesan, B.A., carried out work in the south of Chānda of the same class and scale as that carried out by Camp (1), including a certain amount of revision work reduced from the four-inch forest survey.

Camp (3), under Mr. C. P. E. Davenport did similar work to Camp No. 2 in the Adilābād district.

Camp (4), directly under the Officer in charge of the party, undertook various items *viz.*, surveys for special guide maps of Ellora and Ajanta on the large scale of 1 inch = 250 feet (this scale was chiefly adopted in order to coincide with the scale adopted by James Burgess in the surveys of the interior of the caves); revision survey for the military authorities, and demarcation of boundaries for mineral concessions by fixing points either by triangulation or resection.

There was a certain amount of delay in surveyors getting actually to their areas owing to difficulties in communications and the long march from Peddapalli, which was in some cases as much as six days' journey.

129. *Miscellaneous.*—Negotiations are being carried out with H. E. H. the Nizām's Government, and are proceeding favourably, with regard to this party taking over certain traverse work for them.

In certain areas west of Asifābād many villages recorded on the old quarter-inch sheets have now been evacuated and on investigation it was found that this chiefly happened during the influenza epidemic of 1918-21 when villages, of which the huts only consisted of grass and bamboo, were either wiped out or moved to other inhabited sites. In the country between Adilābād and Rājūra in the time of the old Gond kingdom of Mānikgarh there must have been quite a considerable population where now the country is very sparsely populated. There are many remains of old Jain buildings and fortified villages. Stone circle burials, as found in many other parts of the state, were not located except 15 miles north-west of Peddapalli where there is one large cemetery.

130. *Recess duties.*—During recess Messrs Natesan, Davenport and and Muhd. Abdul Azim have been chiefly responsible for the fair mapping, and have been assisted by Messrs Cabral and Muthanna.

Mr. Meyer was early transferred to No. 8 Party of which he took charge.

It is expected that the fair sheets will be completed before the party takes the field.

12 two-inch special forest maps for H. E. H. the Nizam's Government have been drawn in the party.

No. 7 Party.

Officer in charge.—Major H. T. Morshead, D.S.O., R.E., to 8-11-26.
Mr. S. S. McA'Fee Fielding from 9-11-26 to 30-6-27.
,, V. W. Morton from 1-7-27.

131. *General.*—The party was employed on topographical surveys on the scale of 1 inch = 1 mile in Madras, Madras States, Hyderābād and Mysore (sheets 57 A, E and F); also on special survey of tea and coffee estates in Mysore, on the scale of 16 inches = 1 mile, in sheet 48 O. The field headquarters of the party remained at Bangalore.

132. *Personnel.*—The field strength of the party numbered 1 Class II Officer, 4 Upper Subordinate Service Officers, and 36 Lower Subordinates distributed as under:—

Mr. V. W. Morton (Class II), *Camp* (*1*), 7 surveyors and 5 pupils.

Mr. K. G. Mandanna (U. S. S.), *Camp* (*2*), 1 U. S. S. officer, 5 surveyors and 4 pupils.

Mr. Abdul Ghafur (U. S. S.), assisted by surveyor Ghulam Rasul Khan (Instructor), *Camp* (*3*), 12 pupils.

Three surveyors were employed on the sixteen-inch surveys of tea and coffee estates and were directly under the supervision of the Officer in Charge.

During the field season one U. S. S. officer was transferred to No. 8 party, one surveyor to the Nepāl Survey Detachment and one surveyor to foreign service connected with the Turco-'Irāq Boundary Delimitation Commission.

133. *Areas surveyed.*—4,970 square miles of original survey on the scale of 1 inch = 1 mile were carried out in Anantapur, Bellary and Kurnool districts of Madras, Sandūr State of Madras States, Raichūr district of Hyderābād State, and Chitaldrug and Tumkūr districts of Mysore State, in sheets 57 A, E and F. Also 4,178 acres on the sixteen-inch scale in Kadūr district of Mysore State in sheet No. 48 O.

134. *Topographical surveys.*—*Camp (1)*, under Mr. V. W. Morton, surveyed 2,099 sq. miles on the scale of 1 inch = 1 mile in sheets 57 A and F.

Camp (2), under Mr. K. G. Mandanna, surveyed 1,727 sq. miles on the scale of 1 inch = 1 mile in sheet 57 F.

Camp (3), under Mr. Abdul Ghafur, surveyed 1,144 sq. miles on the scale of 1 inch = 1 mile in sheet 57 E.

The country consisted chiefly of open undulating plains, with low rocky hills here and there. In the neighbourhood of Bellary and in Sandūr State the hills were higher and of more regular formation but were generally destitute of trees. The surveyors experienced a good deal of difficulty, from scarcity of water especially during the hot weather. A partial famine was declared in parts of Bellary and Anantapur districts owing to the failure of the previous monsoon.

135. *Special surveys.*—An area of about 4,178 acres of tea and coffee estates was surveyed on the sixteen-inch scale in sheet 48 O. This work was slow and laborious owing to the very steep and heavily wooded hills on which the estates lie.

Points were fixed for the use of the 12th Brigade R. F. A. in the neighbourhood of Hoskote, a few miles out of Bangalore.

136. *Miscellaneous.*—There were several places of archæological interest in the area under survey; many of the hills were crowned with ancient forts—some, as in Adoni, Bellary and Pāvugada being in a remarkable state of preservation. Mention must also be made of the ruins of Hampi, the site of the capital of the old kingdom of Vijayanagar; the roads leading to and among these ruins are shown on the twelve-inch map prepared by the Madras Revenue Surveys.

The health of the party was generally good though one surveyor had to be invalided owing to malaria. The surveyors working on the tea estates suffered a good deal from the fever for which the Malnād is notorious.

137. *Recess duties.*—The fair mapping of all field work was completed during the year by three sections under Messrs N. S. Harihara Iyer (Class II) who was transferred to the party from No. 4 Drawing Office on 1st July 1927, K. G. Mandanna (U. S. S.) and Abdul Ghafur (U. S. S.).

During recess 1927, seven pupil-surveyors were posted to this party for training under surveyor Ghulam Rasul Khan (Instructor).

For the mapping of the sixteen-inch estate maps, as on previous occasions, 2 traces were prepared of each, one contour and one outline; all necessary typing was done on the traces, as prints in only two colours (black and brown) were required.

Eight sheets of last season's mapping were still in hand when the party took the field, and were completed in January 1927. Mr. Shib Lal (U. S. S.), who had been detailed for the extension of the Cauvery (Mettūr) survey, which had been asked for by the Irrigation Department and was afterwards abandoned, had charge of these sheets.

No. 8 Party.

Officers in charge.—Major L. H. Jackson, I.A., to 21-4-27.
Mr. F. C. Pilcher from 22-4-27 to 30-6-27.
Mr. E. A. Meyer from 1-7-27.

138. *General.*—This party completed the topographical survey on the scale of 1 inch = 1 mile of sheet 58 E in Madras and Mysore; forest surveys on the 4 inches = 1 mile scale in 46 H in Bombay and surveys of private estates on the 16-inch scale in 58 B and C in Madras and the Madras States.

The sphere of operations of the whole party, except the small detachment on the four-inch forest surveys, was changed from Bombay to Madras, with field headquarters at Coimbatore.

139. *Personnel.*—The field strength of the party numbered 4 Class II officers, 4 Upper Subordinate Service officers and 45 Lower Subordinate officers, distributed as under:—

Mr. F. C. Pilcher (Class II), *Camp (1)*, 8 surveyors to 28th February, and thereafter *Camps (1) and (5)*, 11 surveyors, up to 22nd April when this officer assumed charge of the party.

Mr. B. T. Wyatt (Class II), *Camp (2)*, 13 surveyors, traverser and computer, was in charge of special large-scale surveys of private tea and rubber estates.

Mr. M. S. Ganesa Aiyar (Class II), *Camp* (*3*), 12 surveyors.

Mr. S. R. Kelkar, B.Sc., (Class II), *Camp* (*5*), 3 surveyors to 28th February; thereafter this officer was employed on triangulation.

Mr. Shib Lal, R.S., (U. S. S.), *Camps* (*1*) *and* (*5*), 11 surveyors, from 22nd April.

Mr. Saiyid Budhan (U. S. S.), *Camp* (*4*), 4 surveyors, was in charge of four-inch forest surveys.

Mr. H. Narasimhamurti Rao, B.A. and Mr. P. S. Vengusvami (U. S. S.) undertook triangulation and traversing.

140. *Areas surveyed.*—3,168 square miles of original survey and 1,421 square miles of revision survey (excluding 69 square miles of special four-inch survey) were completed on the 1 inch = 1 mile scale in the Coimbatore, Nilgiri, Salem and Trichinopoly districts of Madras, and Mysore district of Mysore State, in sheet 58 E. Also 47·5 square miles of forest survey on the 4 inches = 1 mile scale in the West Nāsik Forest Division, Bombay, in sheet 46 H, and 14,607 acres (22·82 square miles) of special surveys of private tea and rubber estates on the 16-inch scale in the Coimbatore district of Madras, and Travancore State, were surveyed.

78 linear miles of traversing, and 4,382 square miles of triangulation, both in advance for detail survey on the one inch scale, were completed; also 63·5 square miles of triangulation and 4·9 linear miles of traversing for the special estates survey.

141. *Topographical surveys.*—*Camp* (*1*), under Mr. F. C. Pilcher to April and subsequently under Mr. Shib Lal, R.S., completed on the scale of 1 inch = 1 mile in Madras, 1,192 square miles of original and 485 square miles of revision survey. An area of 69 square miles, specially surveyed the previous season on the four-inch scale by No. 7 party in connection with the Cauvery (Mettūr) project, was reduced to the scale of survey for incorporation with this work.

Camp (*3*), under Mr. M. S. Ganesa Aiyar, completed 1,393 square miles of original and 936 square miles of revision survey on the scale of 1 inch = 1 mile in Madras and Mysore. One surveyor also carried out corrections and surveyed a new railway line, both in the adjoining sheet, 58 A.

The country surveyed by these two camps consisted of fairly heavily wooded heights and foothills, and undulating cultivated plains thickly covered with palmyra and cocoanut palms, thorny trees and cactus hedges, with a few isolated, bare, rocky hills scattered over the northern and central portions.

Camp (5) under Mr. S. R. Kelkar, B.Sc. to February, Mr. F. C. Pilcher from 1st March to 21st April, and then under Mr. Shib Lal, R.S. completed 583 square miles of original survey on the scale of 1 inch = 1 mile in sheet in Madras. The country surveyed by this camp comprised a few low detached hills covered with light scrub, and undulating, cultivated plains similar to the other camps. Most of the ground in the southern portion under camps (3) and (5) had to be surveyed by plane-table traverse, which naturally delayed its completion.

There was practically no cold weather, and the months of April and May were excessively hot, though there were a few storms in the early part of the latter.

Camps (2) and (3) had to cover distances of over 40 miles to their areas, but difficulties were obviated by motor buses.

142. *Triangulation.*—In Madras and Pudukkottai State in sheet 58 J, was commenced from a base of the Madura Series of 1916-17 and closed on a base of the Great Arc Series, Section 8° to 18° of 1840-74. The trestle stations of the South-East Coast Series were evidently not observed from.

143. *Traversing.*—Owing to the unsuitability of the country for triangulation in the Rāmnād and Tanjore districts and Pudukkottai State in the south-east corner of 58 J, points had to be fixed by traverse. This impeded the triangulation mentioned above.

144. *Computing and Compiling Section.*—During October and November 1926 the computing section under Mr. S. R. Kelkar, assisted by surveyors from drawing sections, made on Bristol boards, (for the preparation of field sections in blue), prints from four-inch forest reductions and one-inch Madras Revenue Survey sheets, and also the data for plotting. The details shown on these field sections were checked during the field season.

145. *Special surveys.*—Several private tea and rubber estates were surveyed on the 16-inch scale with 25-feet contour intervals, by camp (2) under Mr. B. T. Wyatt who, with a surveyor to assist him, went out in advance of his camp to provide data for the detail survey by triangulation and traversing. To avoid any delay the estates left over for next season were triangulated in advance by Mr. S. R. Kelkar.

At the request of the Chief Conservator of Forests, Bombay, several small areas acquired by the Forest Department were surveyed by Camp (4) on the scale of 4 inches = 1 mile under Mr. Saiyid Budhan. These areas had been left over from the previous season.

146. *Miscellaneous.*– Several herds of wild elephants, with a few

rogues, were seen in the forests in the northern hills of 58 E but fortunately no one met with any mishap. Special arrangements had to be made for three or four men of the Sholga hill forest tribe to accompany surveyors when camped in the heart of the forests, where it was very difficult to obtain supplies and labour.

Practically all isolated hills in the plains of 58 E, have upon them at least one temple of both archæological and historical interest with broad stone steps leading to the summits.

The health of the party was not all that could be desired; seven surveyors fell seriously ill, and had to be sent on medical leave.

147. *Recess duties.*—Fair sheets were drawn by three sections under Messrs Pilcher, Wyatt and Ganesa Aiyar and computations were dealt with by a section under Mr. P. S. Vengusvami assisted by Mr. H. Narasimhamurti Rao. The fair mapping of 6 sheets was completed by the end of the survey year, leaving 14 sheets which will be submitted before the party takes the field.

16-inch estates mapping was carried out as follows; contour sheets were fair-drawn on drawing blue prints for fair originals and contour values typed; headings, names, etc., were correctly typed on similar prints in black which served as outline fair sheets. 6 estates have been fair mapped and the remaining 10 will be completed shortly.

The four-inch forest survey field sections were sent to the Forest Map Office for fair mapping.

VIII.—SURVEY REPORTS, EASTERN CIRCLE.

DIRECTOR:—
Lt.-Colonel A. A. McHarg, D.S.O., R.E., up to 27-10-26.
Lt.-Colonel L. G. Crosthwait, I.A., from 28-10-26 to 22-4-27.
Major F. J. M. King, R.E., from 23-4-27 to 11-5-27.
Lt.-Colonel R. H. Phillimore, D.S.O., R.E., from 12-5-27.

148. Summary.—The units administered by the Eastern Circle were Nos. 4, 9 and 12 Parties, and No. 5 Drawing Office.

In addition to his duties in charge of the Eastern Circle, the Director, as Director of Surveys, Assam, held administrative charge, under the local government of the Assam Traverse Party, the Assam Drawing and Reproducing offices at Shillong, and the Assam Survey School at Jhālukbāri. Also in his capacity as technical adviser on survey matters to the Government of Bengal, he visited the Bengal Survey Office at Alipore and the Bengal Traverse Party in the field.

Office buildings.—The *Bonnie Brae* estate in Shillong has been purchased by the Government of India at a cost of Rs. 80,000 for Eastern Circle units. Rs. 1,68,000 has been approved for the construction of new office buildings on this estate, and these will shortly be put in hand by the Assam Public Works department.

149. *Training.*—Nine pupil surveyors were attached to field parties during the field season and eight new pupils were entertained in April 1927.

150. *The field work* of Parties covered 41 sheets partly or wholly surveyed, as follows:—

No. 4 Party.—Topography on scale 1 inch = 1 mile in sheets 73 I and 73 M.

No. 9 Party.—Topography on scale 1 inch = 1 mile in sheets 73 J and 73 K.

No. 12 Party.—Topography on scales 1 inch = 1 mile and ½ inch = 1 mile in sheets 78 J and 78 K.

No. 4 Party.

Officer in charge.—
Mr. C. C. Byrne, up to 16-11-26.
Major F. B. Scott, I.A., from 17-11-26.

151. *General.*—The party carried out supplementary survey on the scale 1 inch = 1 mile in sheets 73 I and 73 M, in Bihār and Orissa, and Bengal. The four-inch survey of the Jharia coalfield had been completed during the previous season.

The field headquarters of the party were at Dhānbād.

152. *Personnel.*—The field strength of the party numbered 3 Class II officers, 3 Upper Subordinate Service officers and about 30 Lower Subordinate officers distributed as under: –

Mr. J. McCraken, M.B.E., (Class II), with the assistance of Mr. Abdul Aziz Khan (U. S. S.), *Camp (1)*, 5 surveyors and 7 pupils.

Mr. C. O. Picard (Class II), *Camp (2)*, 8 surveyors.

Lieut. C. S. McInnes (Class II), *Camp (3)*, 7 surveyors and 1 pupil.

Mr. A. C. Maulick (U. S. S.) and surveyors Hari Singh and Chintamani Mamgain were employed in triangulation and computer Cheda Lal Bhatnagar in levelling.

Mr. C. O. Picard proceeded on combined leave for 1 year from 5th May 1927.

Mr. N. C. Roy (U. S. S.) was on leave on medical certificate from 11th August 1926 to 9th February 1927, and was attached to No. 5 Drawing office till the close of the field season.

One surveyor resigned and one surveyor was discharged during the field season.

153. *Areas surveyed.*—An area of 3,076 square miles was surveyed on the scale 1 inch = 1 mile, the whole being supplementary survey in sheets 73 I and 73 M, lying in the Hazāribāgh, Mānbhūm and Santāl Parganas districts of Bihār and Orissa, and the Bānkurā and Burdwān districts of Bengal.

An area of 4,070 square miles was triangulated in sheets 73 E and 73 I in the Hazāribāgh, Mānbhūm and Rānchi districts of Bihār and Orissa, and the Bānkurā district of Bengal.

154. *Topographical surveys.*—The work was divided into three camps as shown below :—

Camp (1) Mr. J. McCraken, M.B.E., in charge, mostly in Mānbhūm district with headquarters at Purūlia.

Camp (2) Mr. C. O. Picard, in charge, in the Mānbhūm and Bānkurā districts to the east of Purūlia.

Camp (3) Lieut. C. S. McInnes, in charge, in the north east of sheet 73 I round Asansol.

The country consisted of undulating cultivated ground with small patches of jungle and isolated rocky hills. The cultivated area is irrigated from numerous small tanks.

The whole area was supplementary survey carried out on scale 1 inch = 1 mile on blue-print reductions of recent 16-inch cadastral survey.

155. *Triangulation.*—Triangulation was carried out in sheet 73 E

and in sheet 73 I, mostly in Hazāribāgh and Rānchi districts, on the high ground of the Chotā Nāgpur plateau. Connection was made with triangulation of No. 1 Party to the west.

156. *Levelling.*—54 linear miles of levelling were run, to give heights to trijunction stones and other points already fixed by traverse for Local Government revenue surveys. This has been found more economical than triangulation in flat country.

157. *Forest surveys.*—An area of 9 square miles, included in the total party area was surveyed on the scale 1 inch = 1 mile in the Jaipur and Barābhūm reserved forests of the Chaibāsa Forest Division.

158. *Recess duties.*—The fair mapping was divided into two sections as given below :—

Section (1) Mr. J. McCraken, M.B.E., in charge.

Section (2) Lieut. C. S. McInnes, in charge.

The fair mapping of all field work was completed during the year.

The computing of the triangulation was under the charge of Mr. A. C. Maulick.

No. 9 Party.

Officer in charge.—Mr. B. M. Berrill.

159. *General.*—Topographical surveys on the scale 1 inch = 1 mile was carried out in 73 J and K in Bihār and Orissa and the Bengal Presidency. The field headquarters of the party were at Midnapore (Bengal).

160. *Personnel.*—The field strength of the party numbered 2 Class II officers, 5 Upper Subordinate Service officers and about 30 Lower Subordinate officers, distributed as under :—

Mr. Madras Mahadeva Mudaliar, M.A. (Class II), *Camp (1)*, 10 surveyors.

Mr. Bhupendra Nath Saha, M.Sc. (Class II), *Camp (2)*, 10 surveyors.

Mr. Dhirendra Nath Saha, (U. S. S.), *Camp (3)*, 8 surveyors and 2 pupils.

Messrs B. B. Shome and R. K. Talapatra, (U. S. S.), and surveyor Hari Datta were employed in triangulation and traversing.

Mr. R. E. Saubolle (Class II) returned from leave on 22nd April 1927.

Mr. M. M. Mudaliar (Class II) left on the 4th May 1927 on transfer to Southern Circle.

161. *Areas surveyed.*—The party surveyed on the scale of 1 inch = 1 mile 1,867 square miles of original survey and 1,439 square miles of supplementary survey in 73 J and K, in the Mānbhūm and Singhbhūm

districts and the Feudatory States of Orissa, and in the Bānkurā and Midnapore districts of Bengal. Areas of 1,296 square miles were triangulated and 1,120 square miles traversed in sheet 73 K, in Balasore and Cuttack districts and in the Keonjhar, Mayūrbhanj and Nilgiri Feudatory States of Orissa.

162. *Topographical surveys.—Camp (1)* under Mr. M. M. Mudaliar, surveyed 1,105 square miles of original survey on the scale 1 inch = 1 mile in the Mayūrbhanj and Keonjhar States. The area surveyed comprised a small portion of cultivated and wooded plains, while the major portion was practically the whole of the Simlipāl hills. This group of hills, which forms a forest reserve in the Mayūrbhanj State, rises from about 300 feet to nearly 4,000 feet and presented difficulties akin to unexplored tracts. The tops of the hills are mostly flat and very densely covered with trees so that the surveyors had to build on tree tops, '*machāns*' or platforms varying from 30 to 70 feet above ground. The climate is very unhealthy and this camp suffered much from malarial fever. Only a few hamlets exist on the plateau and these are occupied chiefly by *Kol* settlers, while the poorer jungle tribes known as *Kharias* have no settled homes and live mainly on the forest produce. These hills harbour big game, wild elephants principally, and their tracks together with forest lines are the only paths for moving about, except in areas under timber felling.

Camp (2) under Mr. B. N. Saha surveyed an area of 1,102 square miles partly original and partly supplementary on the scale 1 inch = 1 mile in Singhbhūm and Midnapore districts and Mayūrbhanj State.

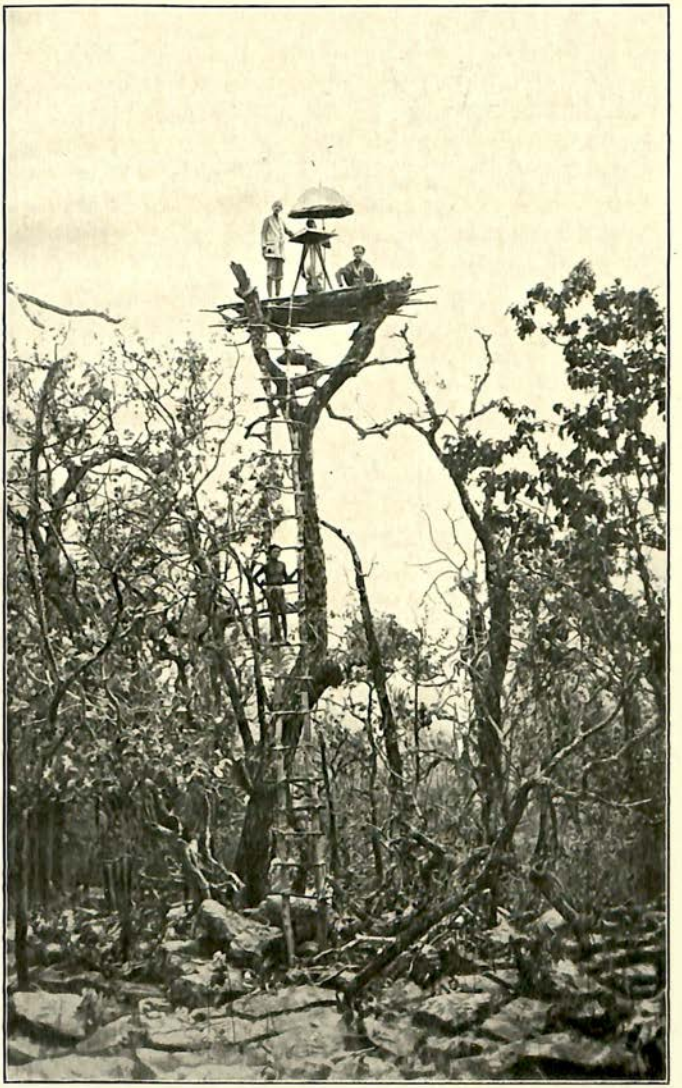
Camp (3) under Mr. D. N. Saha surveyed an area of 1,099 square miles partly original and partly supplementary on the scale 1 inch = 1 mile in Mānbhūm, Singhbhūm, Bānkurā and Midnapore districts.

The country surveyed by camps 2 and 3 consisted of the flat cultivated and wooded plains of Bengal on the east, merging into undulating scrub jungle, low rocky hills and the higher wooded hills of Bihār and Orissa on the west.

163. *Triangulation and Traversing.*—Messrs B. B. Shome and R. K. Talapatra triangulated in the hilly area up till the end of February and then joined surveyor Hari Datta in traversing the low ground of Balasore district and Mayūrbhanj State.

Two computers were employed on traverse computations at field headquarters during the field season.

164. *Forest surveys.*—A special survey of the Simlipāl State Forest in the Mayūrbhanj State was carried out on the scale 1 inch = 1 mile,



A Survey "Machan" in Simlipāl forests, Mayurbhanj State.
Some of these "machans" were as much as 70 feet high.

[See page 72]

showing inter-forest boundaries and the position of all forest bungalows and offices. A special edition of the one-inch sheets will show these additional details surprinted in a special colour.

City surveys.—A surveyor was attached to the Map Publication Office for revising the six-inch map of Calcutta.

165. *Recess duties.*—The fair-mapping sections were as follows:—Section (1) Mr. R. E. Saubolle, Section (2) Mr. B. N. Saha, Section (3) Mr. D. N. Saha. The computing section was under Mr. B. B. Shome. The fair mapping of all field work was completed during the year.

No. 12 Party.

Officer in charge.— Major F. J. M. King, R.E., to 20-4-27.
Mr. E. M. Kenny, from 21-4-27 to 13-6-27.
Major H. R. C. Meade, I.A., from 14-6-27.

166. *General.*—This party carried out topographical surveys on the scales ½ inch and 1 inch = 1 mile with the necessary triangulation and traversing in Assam and Bengal, in degree sheets 78 F, J and K. The field headquarters of the party were at Gauhāti.

167. *Personnel.*—The party, after re-absorption of the Sadiyā Frontier Detachment, consisted of 3 Class II officers, 3 Upper Subordinate Service officers and 33 Lower Subordinate officers distributed as under:—

Mr. P. Simpson (Class II), *Camp (1)*, with 4 surveyors and 1 pupil.
Mr. E. M. Kenny (Class II), *Camp (2)*, with 11 surveyors.
Mr. R. C. Hanson (Class II), *Camp (3)*, with 2 Upper Subordinate Service officers, 6 surveyors and 3 pupils.

Mr. Simpson proceeded on sick leave for 4 months on the 24th March 1927, Mr. Moti Lal Roy (U. S. S.) then taking over his camp.

Mr. S. C. Chatterjee (U. S. S.) and surveyor Muhammad Akbar were employed on triangulation.

168. *Areas surveyed.*—1,816 square miles of original survey were surveyed on the scale 1 inch = 1 mile in Goālpāra and Kāmrūp districts in degree sheets 78 J and K, and 936 square miles of original survey on the scale ½ inch = 1 mile in the Gāro and Khāsi and Jaintiā Hills districts in 78 K.

An area of 5,553 square miles was triangulated and traversed in the Gāro Hills and Goālpāra districts of Assam and in Cooch Behār State, Jalpaiguri and Rangpur districts of Bengal in degree sheets 78 F, J and K.

169. *Topographical surveys.—Camp (1)* under Mr. P. Simpson and *Camp (2)* under Mr. E. M. Kenny carried out original survey on scale 1 inch = 1 mile in the Goālpāra and Kāmrūp districts, sheet 78 J.

The country surveyed by Camps 1 and 2 extends from the Bhutān border southwards to the Brahmaputra river. The country is flat with a few isolated hills in the south-west, and, except for a populous strip along the E. B. Railway line, is covered with high elephant grass and scattered *simal* trees. A great scarcity of water in the country along the Bhutān border caused much trouble. The streams which come down from the Bhutān Hills disappear on entering the plains to reappear some 5 miles further south.

Camp (3) under Mr. R. C. Hanson carried out original survey on the scale ½ inch = 1 mile in the Gāro Hills and Khāsi and Jaintiā Hills districts and on the scale 1 inch = 1 mile in Goālpāra and Kāmrūp districts, sheets 78 J and K.

The country surveyed extends from the Brahmaputra river southwards into the Gāro Hills. The strip of plains between the river and the hills is fairly well wooded with *sāl* trees and the Gāro Hills are forest clad.

170. *Triangulation.*—Mr. S. C. Chatterjee and surveyor Muhammad Akbar triangulated 3,021 square miles in Goālpāra and Gāro Hills districts, sheets 78 J and K.

171. *Traversing.*—Traversing for 1-inch survey was carried out under Mr. Simpson in Goālpāra district and in Cooch Behār State, and in Jalpaiguri and Rangpur districts of Bengal in sheets 78 F and J, where triangulation is impossible.

172. *Forest surveys.*—An area of 285 square miles of reserved forests were surveyed on the scale 1 inch = 1 mile in the Goālpāra and Kāmrūp Forest Divisions. 60 square miles of reserved forests were surveyed on the scale ½ inch = 1 mile in the Gāro Hills Forest Division.

173. *Recess duties.*—The fair mapping was carried out under the supervision of Messrs E. M. Kenny, R. C. Hanson and Moti Lal Roy. Mr. S. C. Chatterjee was in charge of the computing section.

The mapping of all field work was completed during the year.

IX.—SURVEY REPORTS, BURMA CIRCLE.

DIRECTOR:—{Lt.-Colonel E. T. Rich, C.I.E., R.E., up to 2-5-27.
„ L. G. Crosthwait, I.A., from 3-5-27.

174. Summary.—The units administered by the Burma Circle were Nos. 10, 11 and 21 Parties and No. 7 Drawing Office.

175. *Training.*—Of the pupil surveyors and draftsmen under training in the Circle, 20 made satisfactory progress and 3 were discharged as unlikely to become efficient.

In addition 12 new pupils were enlisted during recess and were attached to No. 7 Drawing Office for instruction in drawing.

176. *The field work* of parties was as follows:—

Nos. 10 and 11 Parties.—Topography on the scale of 1 inch = 1 mile, but including small areas on the two-inch and four-inch scales, in Lower Burma.

No. 21 Party.—Survey of reserved forests on the scales of 2 inches and 4 inches = 1 mile in the Central, Chindwin and Hlaing Forest Circles and five forest divisions.

No. 10 Party.

Officer in charge:—{Captain G. Lennox, I.A., to 4-5-27.
Mr. D. K. Rennick, M.B.E., from 5-5-27 to 28-5-27.
Major F. J. M. King, R.E., from 29-5-27.

177. *General.*—The party continued the topographical survey of the western coast line of Burma and the country contiguous, on the scale of 1 inch = 1 mile in sheets 85 K, L and P, 86 I and M and 94 D.

The field headquarters of the party were at Bassein.

178. *Personnel.*—The field strength of the party numbered 3 Class II, 3 Upper Subordinate and 24 Lower Subordinate officers distributed as under:—

Mr. D. K. Rennick, M.B.E. (Class II), *Camp (1)*, with one U. S. S. Officer and 9 surveyors.

Mr. G. A. Norman, M.B.E. (Class II), *Camp (2)*, with one U. S. S. Officer and 11 surveyors.

Captain F. E. R. Calvert (Class II), *Camp (3)*, with one U. S. S. Officer and 4 traversers.

179. *Areas surveyed.*—The party surveyed a total area of 3,060 square miles and carried out traverse over an area of 1,965 square miles in the Bassein, Hanthawaddy, Ma-ubin, Myaungmya and Pyapon,

districts of the Irrawaddy delta, falling in Sheets Nos. 85 K, L and P, 86 I and M and 94 D.

The area surveyed comprised 2,418 square miles of original and supplementary survey and 580 square miles of revision survey on the scale of 1 inch = 1 mile, and 62 square miles of reserved forest on the scale of 2 inches = 1 mile.

180. *Topographical surveys.*—*Camp* (*1*) under Mr. D. K. Rennick, M.B.E., carried out original, supplementary, and revision survey of 1,464 square miles on the scale of 1 inch = 1 mile; and 2 square miles of reserved forest on the scale of 2 inches = 1 mile.

Camp (*2*) under Mr. G. A. Norman, M.B.E., carried out original, supplementary and revision survey of 1,534 square miles on the scale of 1 inch = 1 mile, which included part of the air survey of the Irrawaddy delta of 1923-24; and 60 square miles of reserved forest on the scale of 2 inches = 1 mile.

The area was on the whole difficult, embracing the broken west and south-west coast line of Burma, the wooded Arakan Yomas and the cultivated, creek-intersected country of the Irrawaddy delta.

In the dense forests of the Arakan Yoma, *machans* built on the tops of lopped trees were employed with great success. They were used owing to the immense size of the trees and the undefined features of the hills, where clearing for interpolation by resection was found tedious and laborious.

181. *Traversing.*—Camp (3) under Captain F. E. R. Calvert ran a main traverse line of 127 miles from Tagaung Pagoda Station (Bassein) of the Burma Coastal Series (Minor G. T.) to Lekheik Station of the New Minor Series, triangulated by No. 15 Party in 1926-27. The closing error of this line was 1/737 in Easting and 1/3777 in Southing. Several stations of the old minor series in the Hanthawaddy and Pyapon districts were connected by traverse, revealing a difference of 1·44 chains in Easting and 1·61 chains in Southing between the old and new triangulation series.

A network of traverse of 872 linear miles based on the main traverse, covering an area of about 1,965 square miles in Bassein, Myaungmya, Ma-ubin, Pyapon and Hanthawaddy districts of the Irrawaddy delta and falling in sheets 85 P, 86 M and 94 D was completed.

182. *Special surveys.*—In the Delta Forest Division 62 square miles were surveyed on the scale of 2 inches = 1 mile, comprising the Lebyauk and Kyaukkon reserved forests.

183. *Miscellaneous.*—In the early part of the field season leeches were abundant throughout the area, and in some areas throughout the season. A greater nuisance, however, was the prevalence of ticks, particularly in the forest areas. Insect pests were generally troublesome.

The water supply in the lower portions of the Delta was both bad and scanty, particularly in the area traversed this season. Tanks, with accumulated rain-water, being the only supply in some tracts, bowel complaints were frequent.

The prevalence of cholera, the scourge of the Delta, was successfully combated by the preventive inoculation of the whole personnel of the party; only two deaths amongst the *khalassis* occurred from this disease. Six other *khalassis* died, one of whom was killed by a wild elephant.

The site of old Dalhousie, on the Bassein River, which was one of the early British settlements after the British annexation of the Delta has now only a few tanks marking the site.

Hainggyi, on the island of the same name at the mouth of the Bassein River, a trading settlement of the East India Company in 1687 and the scene of a massacre of the British population in 1759, has an old wall about 25 feet high still standing, apparently a corner of the fort; in this is inset a memorial tablet of comparatively recent date.

184. *Recess duties.*—The mapping of the fifteen fair sheets on the scale 1 ½-inches = 1 mile and of the Lebyauk and Kyaukkon reserved forests on the scale of 2 inches = 1 mile, which was completed during the recess, was divided into two sections under Mr. D. K. Rennick and Captain F.E.R. Calvert.

A computing section under Mr. Ram Prasad, R.S., satisfactorily completed the traverse computation.

No. 11 Party.

Officer in charge:—{Lt.-Col. L. G. Crosthwait, I.A., to 11-10-26. Major J. H. Williams from 12-10-26.

185. *General.*—Topographical surveys mostly on the scale of 1 inch = 1 mile were continued in the Tenasserim division of Burma in sheet No. 94G. A detachment worked in Maymyo and environs.

The field headquarters of the party were at Thaton.

186. *Personnel.*—The field strength of the Party numbered 3 Class

H officers, 5 Upper Subordinate Service officers, and 28 Lower Subordinates, distributed as under:—

Mr. G. E. R. Cooper, *Camp (1)*, with 1 U. S. S. officer and 7 surveyors.

Mr. A. V. Dickson, *Camp (2)*, with 7 surveyors and 1 pupil.

Mr. A. F. Murphy, *Camp (3)*, with 1 U. S. S. officer and 7 surveyors.

U. Po Kyi (U. S. S.), *Camp (4)*, with 6 pupils under training.

Mr. Hayat Muhammad, K. S. (U. S. S.) and 1 surveyor were employed on the Maymyo Guide map.

Mr. Khan Muhammad (U. S. S.) with 1 surveyor and 1 traverser carried out triangulation and traverse.

187. *Areas surveyed.*—The party surveyed a total area of 2,646 square miles, comprising 2,603 square miles on the scale of 1 inch = 1 mile, 2 square miles of reserved forest on the scale of 4 inches = 1 mile, in parts of the Salween, Thaton and Toungoo districts falling in sheet No. 94G, and 41 square miles of the Maymyo Guide Map.

188. *Topographical surveys.—Camp (1)*, under Mr. G. E. R. Cooper, surveyed an area of 918 square miles on the one-inch scale, and Extension No. II of the Kyundaung reserved forest of the Thaton forest division, 2 square miles, on the four-inch scale.

Camp (2), under Mr. A. V. Dickson, surveyed 848 square miles on the one-inch scale.

Camp (3), under Mr. A. F. Murphy, surveyed an area of 837 square miles on the one-inch scale.

Of the area surveyed by these three camps on the scale of 1 inch = 1 mile about 244 square miles were covered by old forest survey maps, or maps compiled from old cadastral surveys. These maps were not contoured and were not always accurate, but where possible use was made of them. The country varied from hills of 6,900 feet to the low valleys along the Salween, Bilin and Yunzalin rivers, where the jungle was very dense and a great deal of plane-table traversing was necessary. Large areas of old *taungya* greatly impeded the movements of surveyors.

The international boundary between Burma and Siam follows part of the Salween and Thaungyin rivers.

Camp (4).—This camp was formed under U. Po Kyi for the training of 6 pupils of whom 3 belonged to No. 10 Party. With the exception of one, who was discharged, they made satisfactory progress.

189. *Triangulation and Traverse.*—An area of 2,120 square miles in the Insein, Pegu and Thaton districts falling in sheet 94 C was trian-

gulated by Mr. Khan Muhammad and surveyor L. M. Ganguli.

The triangulation was supplemented by 92 linear miles of traverse and was connected with the Burma Coast Series No. 52. As this series was being re-observed by the Geodetic Branch the triangulators were able to use the observation trestles which had been erected by No. 15 Party.

In the flat cultivated area between the foot-hills and the Gulf of Martaban the sides of the triangles were from 2 to 4 miles and progress was slow. The results, however, were satisfactory, and a large number of points were fixed.

190. *Special surveys.*—Maymyo Guide Map.—The survey of Maymyo and surrounding country, covering an area of 41 square miles, was completed on the scale of 4 inches = 1 mile, by Mr. Hayat Muhammad and 1 surveyor. Old 16-inch maps were available for 25 square miles of this area, and were reduced to the four-inch scale but required a great deal of supplementary work owing to developments and changes around Maymyo.

The old maps surveyed between 1899 and 1912 of nine reserved forests in the Salween and Thaton Forest Divisions were brought up to date as regards boundaries and pillars, roads, rest-houses, &c. The work was done on blue prints on the scale of the original survey; these were sent to the Forest Map Office for correcting the original fair sheets.

191. *Miscellaneous.*—There was an outbreak of cholera during January and February. Some surveyors having to be recalled several days march in order that the establishments of Camps (2) and (3) might be inoculated with anti-cholera vaccine, considerably delayed the work.

There were 13 deaths from cholera and 3 from fever.

On the west bank of the Salween river a band of seven dacoits attacked and robbed four *khalassis* carrying money, killing two men and seriously wounding the other two.

As in previous years the party employed Yunnanese mules for transport. One of the drivers was killed by a tiger.

192. *Recess duties.*—The mapping of the ten fair sheets, which was completed during the recess, was divided into three sections under Messrs G. E. R. Cooper, A. V. Dickson and A. F. Murphy.

Extension H of the Kyundaung reserved forest was added to the old original fair sheet of this reserve.

Mr. Hayat Muhammad, assisted by Mr. Khan Muhammad, and Surveyor L. M. Ganguli, satisfactorily completed the triangulation and traverse computations.

No. 21 (Burma Forest) Party.

Officer in charge—Mr. J. O. Greiff.

193. *General.*—The *raison d'être* of the party is the survey of reserved forest areas in Burma, on scales larger than the one-inch. The total cost of the party is debitable to the Government of Burma. The party surveyed reserved forests in degree sheets 83 P, 84 M and P, 85 M, N, 93 C and D.

The field headquarters of the party were at Meiktila.

194. *Personnel.*—The field strength of the party numbered 2 Class II Officers, 3 Upper Subordinate Service officers and about 32 Lower Subordinate Service officers, distributed as follows:—

Mr. L. B. Fitz-Gibbon (Class II), and Mr. P. C. Sen Gupta (U.S.S.), *Camp (1)*, 11 surveyors.

Mr. H. M. Critchell (Class II), and Mr. G. S. Bagchi (U. S. S.), *Camp (2)*, 10 surveyors and one pupil.

Mr. Bhamba Ram (U. S. S.), *Camp (3)*, six surveyors and one pupil.

Mr. J. O. Greiff in addition to his executive duties, held charge of *Camp (4)* with 3 surveyors and one pupil.

195. *Area surveyed.*—The total area surveyed on all scales was 509 square miles, including 16 square miles of resurvey on the scale of 4 inches = 1 mile falling in three Forest Circles and five Forest Divisions.

Central Forest Circle.—In the *Yamethin Forest Division* an area of 129 square miles, on the scale 2 inches = 1 mile was surveyed in the Byingye, Natma, Nyaunggaing reserves, and 8 square miles of unclassed forest land adjoining these to show villages and communications.

In the *Meiktila Forest Division* an area of 176 square miles, on the scale 2 inches = 1 mile, was surveyed in the following reserves:—Pyetkaywetaung, Taunggyegôn, Sindaung, and Kubyin Extensions I and II. 22 square miles on the scale 4 inches = 1 mile were surveyed in the Meiktila Fuel, Popa Hill and Popa (Extensions A, B and C) reserves; also 23 square miles of unclassed forest land adjoining these reserves.

In the *Magwe Forest Division* an area of 77 square miles was surveyed, on the scale 2 inches = 1 mile, in the Myindè, Sitha, and Myothit reserves, and 36 square miles on the scale 4 inches = 1 mile in the Kyaukmigyaung West Extension, Yabe West Extensions I and II, and Gyogyaung reserves, and 8 square miles of unclassed forest land adjoining the Myothit reserve.

Hlaing Forest Circle.—In the *Prome Forest Division* 19 sqr. miles on the scale 4 inches = 1 mile was surveyed in the Tônyè Fuel reserve.

Chindwin Forest Circle.—In the *Mu Forest Division* 16 sqr. miles, on the scale 4 inches = 1 mile, was resurveyed in the Nanhlaing reserve.

196. *Distribution of work.—Camp (1),* under Mr. L. B. Fitz-Gibbon, carried out the work in the Mu Division.

Camp (2), under Mr. H. M. Critchell, worked in the Meiktila and Yamethin Forest Divisions.

Camp (3), under Mr. Bhamba Ram, worked in the Magwe Forest Division.

Camp (4), under the Officer in charge of the party, surveyed the detached areas in the Meiktila and Prome Forest Divisions.

The country surveyed was scattered over seven districts, and varied from high hills, in the Yamethin and Meiktila Forest Divisions rising from 3,000 feet to 6,250 feet in elevation, to undulating uplands and plains in the Magwe and Prome Forest Divisions. The former are densely wooded and rocky, the latter open, but cut up by numerous small water courses.

Popa Hill was the most noticeable feature in the Myingyan district. It is a conspicuous conical eminence 4,982 feet high, and is in fact an extinct volcano. The peak is bare, but the slopes are densely wooded with forest growth and garden holdings.

The whole area surveyed is comparatively well served by roads and railways.

197. *Triangulation.*—120 square miles of supplementary triangulation was done by Camp (1) in degree sheets 93 O and P, to provide points on which to close theodolite traverses.

198. *Traversing.*—485 linear miles of forest boundary theodolite traversing, and 57 linear miles of interior and connection traversing, was carried out by Camp (1) to provide data for the ensuing field season. This falls in sheets 83 P and 84 M and in three Forest Divisions, distributed over two Forest Circles.

The traverses were connected with stations of the Manipur Longitudinal and the Mandalay Meridional Series, and with several stations of the tertiary triangulation done by No. 10 party between 1900—1918.

199. *Special surveys.*—At the special request of the Divisional Forest Officers, small holdings and exclusions within the reserves were surveyed on the scale 8 inches = 1 mile. In the Popa Hill reserve there are about a hundred of such holdings, too small for survey on the

four-inch scale. These surveys on the eight-inch scale will be reduced by photography and transferred on to the final four-inch map of the reserves.

Recess duties.—The fair mapping was divided between two sections under Mr. L. B. Fitz-Gibbon and Mr. H. M. Critchell.

All computing work was under the charge of Mr. P. C. Sen Gupta.

At the express wish of the Conservator Working Plans Circle, certain Forest Reserves and Extensions adjoining reserves previously surveyed, have been combined with the old work and mapped on the old fair originals, so as to provide fewer and more compact maps of adjacent reserves.

X.—MISCELLANEOUS SURVEY REPORTS.

200. This section includes all Reports of surveys not administered by the Directors of the five survey circles, such as miscellaneous surveys and commercial levelling administered by the Director, Geodetic Branch, or extra-departmental explorations, etc., in which members of the Department have taken part.

No. 20 Party (Cantonment Surveys).

Officer in charge.—Mr. M. C. Petters.

201. *General.*—The party carries out original and revision surveys of cantonments and military lands as required by the Engineer-in-Chief, and prepares the results for publication. It also incorporates on the originals and office copies of existing cantonment maps the changes in buildings, roads, boundaries, etc., communicated annually by the Commanding Royal Engineers of districts, so as to have up-to-date materials for the publication of new editions when required.

The permanent headquarters of the party are at Dehra Dūn, under the administration of the Director, Geodetic Branch; field headquarters were at Quetta during the survey of Fort Sandeman cantonment and at Lahore for the survey of Lahore, Amritsar and Multān cantonments.

202. The field strength consisted of 10 surveyors and 1 computor under the supervision of Mr. J. M. Mukerji (U.S.S.) and carried out the following work:—

Surveys.—The cantonments of Fort Sandeman, Lahore including Chak Bhaikewāl, Multān and Amritsar, representing an area of 15,335 acres were revised on the scale of 16 inches=1 mile.

Traversing.—To supply data for the detail survey, 100·01 linear miles of theodolite traversing were carried out; the closing error was 0·6 per 1,000.

Levelling.—Lines of level aggregating 57·39 linear miles were run at suitable intervals in the cantonments as the control on which contouring at 5 feet vertical intervals was based. The average error amounted to 0·3 inches per mile.

203. *Recess Duties.*—The fair maps of Rāwalpindi (10), Ferozepore (4), Loralai (2), Chaman (4), Fort Sandeman (2), Lahore (2) and Quetta (8) contonments, a total of 32 sheets, on the scales of 16 inches and 12 inches=1 mile, were completed for publication under the supervision of Mr. A. B. Hunter (Class II) assisted by draftsman Ashik Husain. In addition, the annual corrections supplied by Commanding Royal Engineers

of districts affecting 233 sheets falling in 93 cantonments were entered on the office copies and originals of the plans concerned.

No. 17 Party (Levelling).

Officer in charge.—{Lt.-Colonel V. R. Cotter, I.A., up to 30-4-27.
{Mr. N. R. Mazumdar, from 1-5-27.

204. *General.*—The party is responsible for all geodetic levelling, (see p. 14) and also secondary and tertiary levelling for commercial purposes as described below. A fuller account will be given in the Geodetic Report, 1926-27.

205. *Personnel.*—The field strength was 1 Class II officer, 8 Upper Subordinate officers, 21 Lower Subordinate officers and 57 purely temporary levellers, clerks, &c.

Mr. N. R. Mazumdar (Class II) was incharge of the group doing secondary and tertiary levelling for the Haveli Project of the Punjab Irrigation Department. He was assisted by Messrs I. K. Ponnappa and B. P. Rundev (U. S. S.) who did the secondary levelling of the Project in the earlier part of the season, and latterly computations. There were 3 Lower Subordinate Service officers incharge of three tertiary levelling camps with one camp assistant and 12 to 14 levellers in each section.

Mr. D. H. Luxa (Class II), temporarily lend by the Officer in charge, Computing and Tidal Party, with one Lower Subordinate officer as second leveller and two recorders, executed the secondary levelling for the Burma Government.

Mr. K. K. Das (U. S. S.) was incharge of the computations at headquarters with a computer under him.

Mr. S. C. Mukerjee (U. S. S.) with Mr. J. N. Kohli (U. S. S.) as second leveller, and two recorders was employed in secondary levelling for the E. I. Railway, Calcutta Port Trust and the Bengal Government.

206. Secondary Levelling.

For East Indian Railway.—		
Ghāziābād-Cawnpore ...	...	289 miles.
For Calcutta Port Trust.—		
In Bally	...	2 miles.
Dakhineswar-Hastings ...	...	11 ,,
Hastings-Pujāli ...	...	18 ,,
For Bengal Government.—		
Khulnā-Mādāripur ...	...	77 miles.
Mollāhāt-Barisāl ...	...	97 ,,
Kachuā-Alipur ...	...	62 ,,

For Burma Government.—

Thanatpin-Tongyi ...	...	26 miles.
Ohne-Thongwa-Ohne ...	...	85 ,,

For Punjab Government (Haveli Project).—

Garh Mahārāja-Dāmāniā	...	55 miles.
Dāmāniā-Aharbelā ...	...	37 ,,
Rangpur-Muzaffargarh ...	...	53 ,,
Muzaffargarh-Basti Maluk with a branch line to Rohillānwāli	...	50 ,,
Shujābād-Sabuwāli ...	...	22 ,,
Basti Maluk-Kabirwāla ...	...	62 ,,
Aharbelā-Multān ...	...	34 ,,

207. *Tertiary levelling* for the Haveli Project covered an area of 1,905 sq. miles and comprised 1,140 miles of double levelling and 10,587 miles of single levelling. The levellers followed the lines cleared by the rectangulators, instead of clearing their own lines, as they had to do for the Sutlej Valley Project. This change saved some time and expense.

The rectangulation and levelling of this Project were done in the same season. As rectangulation was not sufficiently ahead when the levellers took the field, their progress was checked. For economy, it is desirable that rectangulation should be done a season ahead of levelling.

The cost rates of tertiary levelling, which include 14 per cent for supervision and instrumental charges, work out to Rs. 48·7 per square mile or Rs. 6·3 per linear mile.

Training School, Dehra Dūn.

Officer in charge.—Mr. S. F. Norman.

208. Sixteen probationers were appointed to the Upper Subordinate Service; of these, 14 reported for training on the 22nd November 1926.

After preliminary instructions at Dehra Dūn, the unit took the field on the 8th December 1926 for instruction in planetabling. Detail survey on the scale of 4 and 2 inches to 1 mile was undertaken, and an area of 8 and 16 square miles, respectively, was completed by each pupil, after which the unit returned to Dehra Dūn for instruction in traingulation, traversing and levelling.

During the recess season one Upper Subordinate officer and five surveyors from the several circles were trained in cantonment and large-scale surveys, and a 'refresher' course was given to those officers from the Circles who could be spared.

Shaksgam Valley Exploration.

Officer in charge.—Major K. Mason, M.C., R.E.

209. An expedition was sanctioned by the Government of India towards the end of 1925 to explore and survey the sources of the Shaksgam river and the Aghil range, which lie beyond the Karakoram range. Major Kenneth Mason, M.C., R.E., Survey of India, was placed in charge of the work. His party consisted of Major H. D. Minchinton, M.C., 1st Gurkhas, Major R. C. Clifford, D.S.O., M.C., I.M.S., Captain F. O. Cave, M.C., the Rifle Brigade, and Khan Sahib Afraz Gul Khan, (U. S. S.), Survey of India. Three Gurkha sepoys and one havildar from No. 18 Party, Survey of India, were the only down-country personnel employed.

Supplies and fodder for transport were arranged for in Leh and the Nubra valley; some difficulties were caused on the Himalayan passes by late spring falls of snow. The expedition, taking the Central Asian trade route as far as the Karakoram pass, reached the headwaters of the Yārkand river at the end of June and crossed into unexplored ground at the source of the Shaksgam on 2nd July, with a caravan of about 160 ponies and 24 Ladakhi porters.

The head basin of the Shaksgam was first explored. The valley was found to be blocked by a large glacier which descends from the northern wall of the Karakoram range, in the neighbourhood of the Apsarasas group and Teram Kangri. A fine view was however obtained from the mountains east of the glacier, as far as K^2 and the Gasherbrum peaks, and the valley beyond the block was surveyed by planetable and Wild photo.-theodolite. There is no doubt that this valley is a continuation of the one ascended by Sir Francis Younghusband from the foot of the Aghil pass in 1889. No useful object would have been gained by forcing the glacier with a small party and merely traversing the ground that could be seen from the stations; and as the ponies were becoming weaker from lack of grass, it was decided to make a new base at the head of a tributary to the Yārkand river, discovered by Major H. Wood, R.E., Survey of India, in 1914.

From this new base, Major Mason took a party across the glaciers at the head, explored and surveyed the barren valleys beyond, and discovered a high plateau, whose existence was previously unsuspected. This plateau was surveyed and a way found westwards to a previously unknown river, which at first was believed to be the middle course of the Shaksgam river; it subsequently turned out to be a large tributary to this river, but the junction could not be reached owing to the amount of water caused by the melting of the snows.

As a result of these explorations about 1,500 square miles of previously unknown country have been surveyed on the half-inch scale, and this area will be increased when the topography plotted in Switzerland by the Wild Stereo-Autograph is included. This area includes the whole head basin of the Shaksgam, its upper sources and tributaries, and its first large feeder glacier; a very large portion of the series of parallel ridges of the Aghil range, whose altitude has for the first time been determined; the head basins of the Yārkand tributaries discovered in 1914 by Major Wood; and the Aghil Depsang plateau. Some very fine views of K^2, the second highest mountain of the earth, and of the other great peaks have been obtained. Zoological, botanical, and geological collections have been made and have now been worked out by experts. A complete series of cirrus cloud and other meteorological observations were made, and a detailed examination of the extensions of the range axes was carried out. On the return of the expedition, a quarter-inch survey of the country and glaciers between the upper Shyok and Pānāmik in the Nubra valley was made by the Khan Sahib, and photographs were taken with the Wild photo.-theodolite of the lower Nubra. These have now been plotted on the Autograph in Switzerland and it is hoped to bring up to date the existing map of this portion of the trade route. The old 'atlas' map of this district has long been known to be inaccurate.

The whole area explored is extremely barren. Peaks of 21,000 and 22,000 feet are common. The party was for three months almost continuously over an altitude of 16,000 feet, with stations much higher. Grass and fuel were very scanty, and to the lack of grass must be attributed the high mortality among baggage animals. Of 21 ponies bought, ten died from various causes and there were 20 deaths among the hired animals The health of the party was good on the whole, but a few accidents occurred. The most serious of these was due to a fall of the hillside, which fractured the skull of one of the men. Thanks to Major Clifford, this man completely recovered, and the party broke up fit and well in Srinagar in November.

An account of the expedition was given to the Royal Geographical Society on 24th January, 1927 and published in the *Geographical Journal* for April 1927. The results of the Stereographic Survey Experiments with the Wild instruments were read before the Royal Geographical Society on 9th May, 1927 and were published together with a description of the Autograph in the *Geographical Journal* for October 1927. A full report giving the scientific results, including brief contributions and classifications of the collections by Natural History Experts is

now under preparation and will be published in the "Records of the Survey of India".

Exploration in the Hunza Valley.

210. An expedition led by Mr. C. F. Montagnier, a member of the Alpine Club and Captain C. J. Morris, 3rd Q. A. O. Gurkha Rifles, left Srinagar about the middle of May, with the object of completing the exploration of the gap between the Visser Expedition of 1925 and Major K. Mason's Shaksgam expedition of 1926. Surveyor Torabaz Khan, Survey of India, was deputed to accompany the party.

The party was stopped at Shingshāl about the middle of July and political considerations prevented them from crossing the pass into the Shaksgam Valley; but surveys were completed of the hitherto unsurveyed and difficult valley of the Ghujerāb; of the previously unsurveyed Yashkuk Glacier; and of the indifferently surveyed Chapursān Valley. It was also intended to survey the Toltar Glacier west of the Batūra Glacier, but time was too short.

An area of about 300 square miles on the scale of $\frac{1}{2}$ inch to 1 mile was surveyed in the Ghujerāb Valley, falling in sheets 42 L & P, and about 660 square miles in the Chapursān Valley and Yashkuk Glacier in sheet 42 L. The country surveyed is probably as difficult as any in the world.

Both Mr. Montagnier and Captain Morris have referred in high terms of appreciation to the industry and energy displayed by Torabaz Khan, by whom the whole of this survey was carried out.

APPENDIX I.

Annual Reports of the Survey of India.

1. After considerable vicissitudes during the past few years our Annual Reports have at last reached a stage where we may usefully review the history of the problem and the conditions leading to the present solution.

2. Up to 1877 three separate Annual Reports were published by the Revenue, Topographical and Trigonometrical Branches. From 1877 to 1900 these were combined in one large volume giving very full reports on the work of all units. Since 1900 the General Report has been published in a condensed form and has been supplemented by a second volume, which consisted up to 1909 of selected "Extracts from Narrative Reports", after which this supplementary publication took the form of an annual volume of the "Records of the Survey of India", which gave a full narrative report of the work of all units. Under this system, which continued from 1909 to 1922, much information was published twice over condensed in the General Report and elaborated in the "Records" Volumes, and a large number of identical Index maps appeared in both publications. Also owing to the stress laid on topographical surveys, all other work was relegated to separate parts of the volumes, so that one did not get a complete consecutive statement of the whole work of each unit.

3. The publication of the annual "Records" Volumes was stopped after 1922, owing to retrenchment and other difficulties; material for them was however prepared in the same form as before, by all units, and was bound up in the manuscript for all Circles, pending a decision as to some more satisfactory solution. These manuscript records were very unsatisfactory and could only be regarded as a temporary makeshift; while the published General Reports became balder and more condensed than ever, and were reduced to octavo size, in accordance with the new policy of Government in regard to official publications.

4. First attempts at the present form of publication were adopted for the Reports of 1924-25 and 1925-26; but these were still supplemented by the makeshift of binding together full manuscript reports based on the old system and not prepared in a durable form. The present year is thus the first in which we have been able to establish a complete

solution to replace the system which terminated in 1922 with the publication of the last of the Annual "Records" Volumes.

5. The new system greatly reduces the delays of publication by grouping the reports into 3 separate volumes for which different officers are responsible, as follows:—

(*a*) *The Map Publication and Office Work Report* is prepared by the Director, Map Publication and corresponds with the financial year terminating on the 31st March. It can therefore be printed at Calcutta before the material for the General Report is received. It includes in a compact and accessible form all statistics of drawing and publication offices, with Index maps showing progress of the various series of maps on different scales published by the Department.

(*b*) *The Geodetic Report* is prepared by the Director, Geodetic Branch for the survey year ending 30th September. It includes full reports of all scientific work for the use of specialists, with appropriate Index maps. It is printed independently at Dehra Dūn, so that other Reports are no longer delayed by the laborious proof corrections and other sources of delay inevitable in scientific publications.

A combined volume is being published for the years 1922-23, to fill the hiatus arising from the cessation of the Annual Records Volume since 1922. Annual volumes are under publication for subsequent years, and it is hoped to have the series complete and up to date by next year.

(*c*) *The General Report* includes brief abstracts of the above two Reports, sufficient for general purposes. It is prepared by the Assistant Surveyor General at Calcutta and corresponds with the survey year to 30th September, so that it will appear later than the Map Publication Report and need not repeat the Index maps showing progress of map publication; nor does it include any of the Index maps of geodetic work which appear in the Geodetic Report. We are thus able to free this General Report from the bewildering variety of Indexes with which it used to be burdened, and confine it to one single Index map showing the progress of topographical surveys since 1905, which is the prime work of the Department.

On the other hand the General Report now gives a fuller account of the work of all field survey operations, in place of the bald summaries which used to be supplemented by fuller reports in the Annual "Records" Volumes. Also the whole work of each unit is given in a single compact statement, instead of being scattered over various Parts of the Report according to the nature of work. The object of this previous separation of the work into Parts is now better met by Abstract I, which enables anyone interested in a particular form of work, *e.g.*, forest surveys, or in a particular area, to look up all relevant parts of the Report without difficulty.

6. *Supplements.* The Map Publication and Geodetic Reports are complete and need no Supplement; but the General Report does not give minor statistics regarding surveys, which are needed for departmental reference, and also its Index map is on too small a scale to show exact details of survey operations. Each survey unit therefore now prepares a "Technical Supplement" giving minor statistics of departmental interest, and also "Detail Index maps" showing exactly the work of each year on

all scales of survey. A few copies of these are prepared in durable form, and are bound *in manuscript* for future reference in the Department. By these means all essential needs are being met with much economy of labour and a very great increase in the promptitude of publication. Thus the exclusion from the General Report of minor details of all kinds makes it possible to get most of the material to press in the summer, so as to have the whole of it nearly ready for publication by the close of the survey year on 30th September; it can thus be bound and issued about a year earlier than was possible under previous conditions.

7. The survey reports of the General Report will also be supplemented from time to time by occasional volumes of the "Records of the Survey of India" which will give a full account of special survey operations of exceptional interest.

8. *Minor improvements* of various kinds have also been introduced into all the Reports. Perhaps the most valuable of these is the attempt to show future work on the Index maps; thus the General Report Index indicates the probable *locale* of survey operations for the coming field season, while the Map Publication indexes show maps in hand and likely to be published in the near future, in addition to those already published up to the date of completion of the Report. This procedure, combined with prompter publication of the Reports, will give all current information almost up to the date when the next volumes will become available.

9. These changes have been effected during a period of considerable difficulty, and many imperfections still remain which can only be set right by the light of further experience of the new system.

APPENDIX II.

The First Survey of Nepāl, 1924-1927.

1. In 1924 His Highness Maharaja Sir Chandra Shamsher Jung Bahadur, Rana G.C.B., G.C.S.I., G.C.M.G., G.C.V.O., D.C.L., Honorary General in the British Army and Colonel of the 4th Gurkha Rifles, Prime Minister and Marshal Supreme Commander-in-Chief of Nepāl, asked for the co-operation of Indian Surveyors of the Survey of India in preparing complete modern maps of the whole of Nepāl. This enlightened act has resulted in one of the greatest single contributions to Himalayan Geography which has ever been made, by giving us for the first time accurate knowledge of the drainage and structure of 55,000 square miles of country (an area approximately equal to that of England and Wales), extending over some of the greatest mountains of the world, and including the highest known peak, Mount Everest, which is over 29,000 feet above sea level. This work consitutes such a valuable addition to geographical knowledge that a skeleton map of Nepāl is published as a frontispiece to the present General Report in order to furnish geographers of all countries with the main outlines of the country, pending the preparation of maps on larger scales*.

2. A complete contoured map on the scale of 8 miles to 1 inch was required, but the field work was carried out on the more convenient scale of 4 miles to 1 inch. A special 8-mile map is now being prepared in three sheets, after which the new information will be incorporated in revised editions of the Standard degree sheets on the scale of $\frac{1}{4}$ inch to 1 mile.

3. Two Nepālese officers, Lt.-Colonel Ganesh Bahadur Chattri and Captain Ganj Bahadur Karki, were placed in control of the survey, and their ability and untiring efforts in organising transport and supplies in a most difficult country were the main essentials in the successful accomplishment of the whole work.

4. *Season 1924-25.* Work commenced at Kātmāndu in November 1924, when Messrs Jugal Behari Lal and Lalbir Singh of the Upper Subordinate Service of the Survey of India, with one surveyor and one computer, also of the Survey of India, reported themselves to the Nepālese officers in charge.

*The Director, Geodetic Branch, Survey of India, Dehra Dūn, will supply spare copies of this skeleton-map to any geographers or scientists who may require it.

The small scale of survey and the desirability of starting the plane-tabling without delay, combined with the difficulty of carrying triangulation through the Tarai country, made it unnecessary to follow the rigorous methods of triangulation normally carried out inside India. Direct connection with the Indian triangulation was therefore dispensed with during the first season and the position of Kaulia (a station near Kātmāndu fixed by Captain H. Wood, R.E., in 1903 by theodolite resection from distant peaks) was accepted as correct. A base of 3,600 feet was measured at Kātmāndu, and from this Mr. Jugal Behari Lal carried out triangulation over an area of 8,000 square miles. Mr. Lalbir Singh and one surveyor meanwhile completed the survey of 7,925 square miles on the ½-inch scale over the same area.

5. *Season 1925-26.* The strength of the detachment was raised to fourteen by the addition of ten more surveyors. Mr. Jugal Behari Lal remained in charge, and in addition to supervising the surveyors he extended the triangulation with the assistance of Mr. Lalbir Singh.

This season Mr. Jugal Behari Lal based his triangulation on existing Indian triangulation on the Kumaun-Nepāl border, and proceeded in a south-easterly direction as far as Bānjkot (Lat. 28° 58′, Long. 81° 14′), where he connected with a similar series executed by Mr. Lalbir Singh and emanating from old triangulation on the southern border of Nepāl in longitude 84° 20′. An area of 19,250 square miles was adequately covered with triangulated points.

The season's outturn of topography amounted to 33,045 square miles. This was inspected as far as possible by Messrs Jugal Behari Lal and Lalbir Singh, ably assisted by the two Nepālese officers previously mentioned. In addition to the data provided by the new triangulation, use was made of peaks fixed from old triangulation in the plains of India and from the Darjeeling triangulation to the east. The latter, especially, enabled a large area to be surveyed without any fresh triangulation.

6. *Season 1926-27.* The detachment remained at the same strength, with personnel unchanged, and completed the topography, covering an area of 14,025 square miles. Field work was finally closed in March 1927.

7. *Results.* The total area surveyed, 55,000 square miles, covers the whole of Nepāl up to the borders of previous Indian Surveys. Three small areas had to be omitted (*vide* frontispiece). The first is a small gap (60 square miles) north of Manang Bhot near the main

axis of the Himālaya, where work was stopped by continuous snow storms; the second (150 square miles), north of Jagdol Lekh, was only roughly sketched on account of bad weather; the third, near Rasua Garhi on the Tibet border, was invisible from the Nepāl side, and could only have been surveyed by crossing the border into Tibet. The Nepālese Government proposes to have these blanks filled in as soon as possible by its own surveyors.

8. *The country* surveyed presents great diversities of climate and relief. On the south it is bordered by a low-lying tract of Tarai, covered with forest and very malarious. The centre of the country consists of steep hills 5,000 to 10,000 feet high, largely forest covered and intersected by deep valleys. It is bordered on the north by the main axis of the Himālaya, a region of high cliffs and perpetual snow, where survey is made additionally difficult by mist and cloud.

9. *Accuracy of the Survey.* Considering that the triangulation had to be carried out concurrently with the topography in the first two seasons, and the many difficulties presented by the country, the resulting surveys show evidence of a very satisfactory degree of accuracy. It is believed to contain very few inaccuracies which will be appreciable on the scale of 8 miles to the inch. None of the stations of the triangulation are likely to be as much as 100 feet wrong in position or 20 feet in height. The junction of two series at Bānjkot (para. 5) revealed closing errors of 0″·51 in latitude, 0″·87 in longitude, and 15 feet in height. Apart from a few cases of doubtful identification, fixings of distant peaks whose positions were previously known agree within 250 feet in position and 50 feet in height. The agreement is generally much closer. It is believed that the maximum errors of topography can hardly exceed half a mile anywhere, and that the average error of planetable fixings throughout the work should be well within one quarter of a mile, or about one thirtieth of an inch on the 8-mile scale.

The successful completion of this survey in the short time of three years, in spite of the difficulties of climate and topography, is a notable achievement and reflects great credit on all the officers and surveyors concerned.

10. *Nomenclature of the peaks.* The Nepālese only give specific names to a few snow-covered peaks of remarkable aspect, but each group of snowy peaks is called a Himāl* or "Abode of snow", and receives a

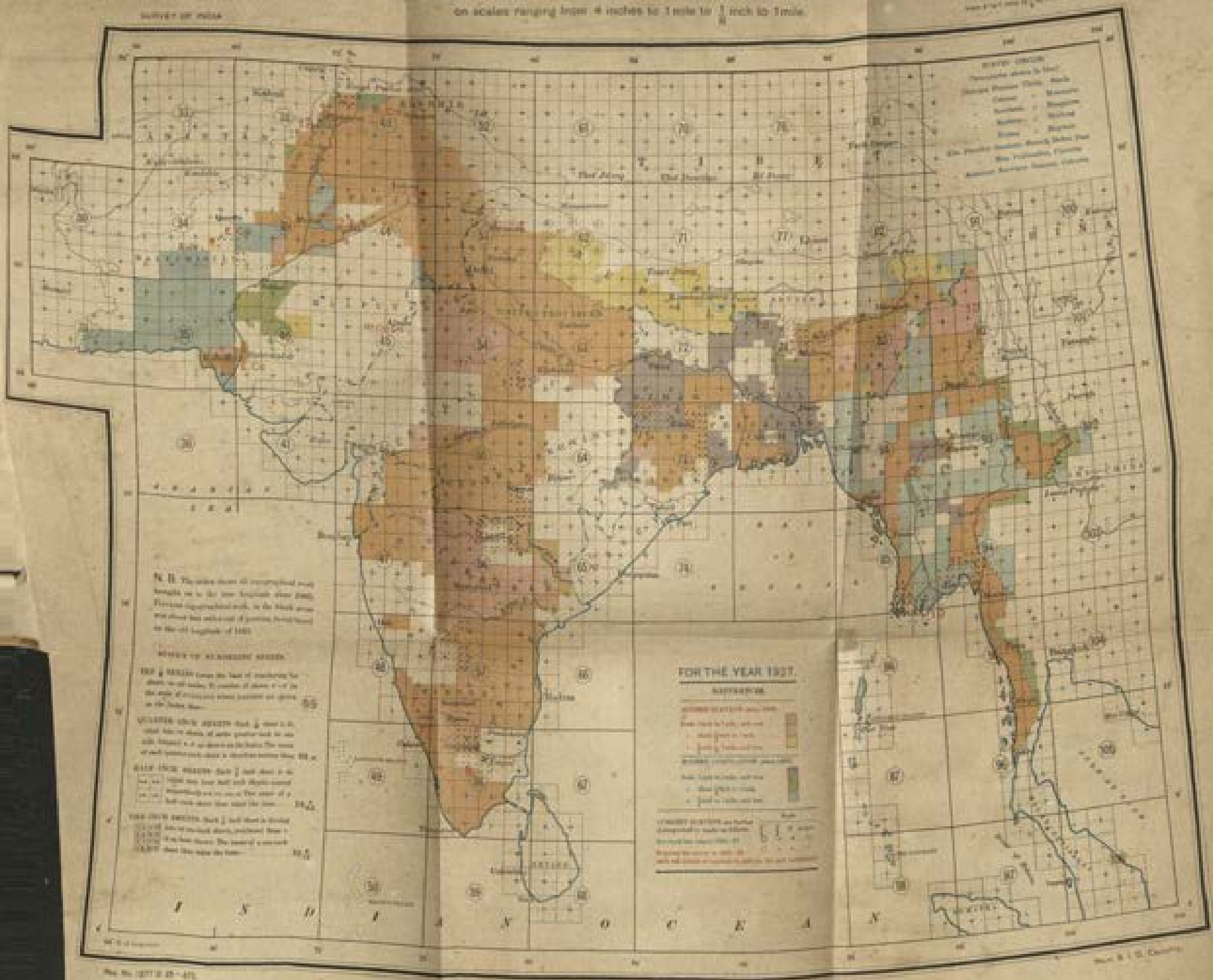
*The Hindi contraction *Himāl* is generally used in Nepāl and the Eastern Himālayas in place of the Sanscrit *Himālaya* used further west.

name. Thus *Mount Everest* dominates the Māhā Langur Himāl; *Kinchinjunga*, the Singālilā Himāl; *Dhaulāgiri*, a Himāl of the same name; *Gaurī Sankar*, the Rolwāling Himāl; and *Api*, the Viyās Rishi Himāl. Mount Everest itself, whose steep southern face carries little snow, is inconspicuous from the south and has received no Nepālese name. It has recently been suggested that the Tibetans give Mount Everest the name of Chomolomo, but Lt.-Colonel Ganesh Bahādur, of Nepāl, considers that this name is used for the whole northern side of the Māhā Langur Himāl, and that it is not the name of the peak.

In view of Captain Wood's work in 1903 and the full summary of the situation published in 1904 in "Nature", Voloume LXXI, pages 42-46, it is surprising that some European geographers still persist in giving the name Gaurī Sankar to Mount Everest. By enquiry in the immediate neighbourhood, the name of Gaurī Sankar was definitely found to apply to the *twin peaks* (23,440 feet) situated over 30 miles West of Mount Everest, as identified by Captain H. Wood in 1903. The local inhabitants frequently use the alternative name of Gaurā Parbatta. Either name implies the idea of *Shiva and his wife*, and is suitable to these twin peaks but would be quite inapplicable to the isolated pyramid forming the summit of Mount Everest.

MODERN TOPOGRAPHICAL SURVEYS AND COMPILATION

on scales ranging from 4 inches to 1 mile to $\frac{1}{8}$ inch to 1 mile.



Scale 1:12,000,000

NOTE

INDEXES showing MAPS PUBLISHED to date on various scales by the Survey of India are bound with the annual Map Publication Report.

INDEXES illustrating Geodetic Operations are bound with the annual Geodetic Report.

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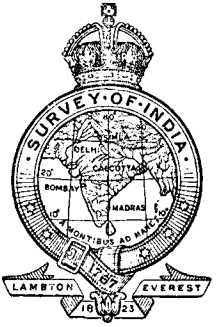

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ABBREVIATIONS:—

C. G. R.	...	Confidential Supplement to the General Report.
T. S.	...	Technical Supplement to the General Report. (including Annual Record Volumes of the Topographical Survey Circles and Geodetic Branch, 1922-26).
Rec.	...	Records of the Survey of India.
G. R.	...	General Report of the Survey of India.
Narr.	...	Extracts from Narrative Reports.
Geod. R.	...	Geodetic Report.

NOTES.

Information which is common knowledge has been excluded.

Part I, arranged by locality names, contains special information as to local conditions (climate, communications, transport, supplies, labour) and particular surveys.

Part II, information of universal interest.

Record Volumes. In order to save space, published Record Volumes are referred to by number only, but other reports by their dates.

The respective survey years of Record Volumes are as follows:—

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	III	1911-12		XV	1919-20
	IV	1911-13		XVI	1920-21
	V	1912-13		XVII	1923 (Sir A. Stein's maps).
	VI	1912-13			
	VII	1913-14		XVIII	1921-22
	VIII	1865-92		XIX	1901-20 (Magnetic Survey).
	VIII(A)	1914			
	IX	1914-15		XX	1914-20 (The War Record).
	X	1915-16			
	XI	1916-17		XXI	1922-24
	XII	1919 (Survey of India Maps).		XXII	1926

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(Arranged by locality names).

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